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Railways, Street and Electric Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous Contracts and Supplies.

The three 16-in. gun lathes, now being made by the Pond Machine Tool Co., of Plainfield, N. J., for the Ordnance Department, weigh 153,300 lbs. each, or 460,000 lbs. in all, and are believed to be the largest and heaviest machine tools ever built anywhere in the world. The same firm has already made for the department 23 lathes and two rifling machines for the manufacture of 8-in. to 12-in. breech-loading guns. The fact that there were four other bidders for this work shows the capacity of American shops for the heavy work required by the new departure in ordnance material.

An outfall sewer from the Los Angeles city limits to the Pacific Ocean, some 12½ miles, has just been completed. The sewer ranges from 36 to 40 ins. in diameter and is for the most part of wood stave pipe, with iron and with brick substituted where necessary. A number of siphons and tunnels are included in the work. The sewer is so located and outlets are so placed as to make possible the use of the sewerage for irrigating large tracts of land. Mr. J. H. Dockweiler is city engineer of Los Angeles, and, it is reported, had charge of the work. An outline of the scheme was given in our issue of Feb. 23, 1893, in the series of articles on "Sewage Purification in America."

Wood stave joints in place of lead have recently been used on some 14,000 ft. of 20, 12 and 10-in. water mains at Dartmouth, N. S., most of which was the gravity supply main of the new works supplying water to the city. The staves are of the best white pine, cut to the curve of the pipe. They are 4 to 5 ins. long, 3 ins. wide and about ⅛ in. thicker than the space they are designed to fill. In making the joint, steel wedges are driven into the space between the hub and spigot in order to force the spigot up against the hub. The lower third of the space is then tightly driven with staves and the steel wedges removed and driven in at the top. After filling the remainder of the space with staves, wedges are driven in between each stave to still further tighten the joint. One great difficulty found in using wood joints is the roughness of the castings, projecting pieces of iron slivering or shaving the wedge. It is estimated that wood joints at Dartmouth effected savings as follows, the figures also including the actual cost of the wood joints:

Diameter pipe. ins.	Cost, including laying. Wood.	Lead.	Saving per joint.	No. joints.	Total saving
20	$1.38	$2.30	$.92	205	$189
12	.90	1.45	.55	870	479
10	.77	1.25	.48	125	60
Total saving....					....$728

In addition it is stated that the expense of a cofferdam in laying 300 ft. of pipe, partially under water, was also saved, but of course cold lead joints would have obviated the necessity of a cofferdam. The engineer in charge of the work was Mr. C. E. W. Dodwell, M. Inst. C. E. at first, and subsequently Mr. W. G. Yorston. The plans for the works were made by Mr. E. H. Keating, M. Am., Soc. C. E., and agreed in many respects with an early report by Mr. Thomas Keefer, M. Am. Soc. C. E. The above information is from a paper by Mr. F. A. Creighton, read before the Canadian Society of Civil Engineers, March 1, 1894.

World's Fair buildings are at a discount. Bids opened on March 10, by the South Park Commissioners, show $15,001 offered for 20 buildings. The best bid was one of $15,100 for ten buildings. Another company offered $15,025 for the Agricultural, Transportation, Electricity, Mines and Machinery buildings; five in all. For the Manufactures Building alone $10,000 was offered. Under the rules of the Commissioners, the Woman's and the Fisheries buildings must be removed by Sept. 1, 1894; certain other structures by May 1, 1895, and all buildings must be down by May 1, 1896. The Commissioners finally decided to reject all the bids.

The most serious railway accident of the week was a wreck caused by a landslide on the Union Pacific Ry., near Boise City, Idaho, March 13. Owing to heavy rains the sides of a steep cut 40 ft. deep slipped and covered the track several feet deep. A passenger train ran into the obstruction and the engine, baggage car, express car and mail car were wrecked. Three men were killed and three injured, one of the latter fatally.——A sand drift, about 12 ins. deep, on the tracks of the Chicago, Rock Island & Pacific Ry., near Limon, Colo., was run into by a freight train March 10. The engine and several cars were wrecked and five men were injured, two of them fatally.

The dam of the Indian Creek irrigation reservoir near Boise, Idaho, gave way March 13, and the flood caused much damage to farms and towns along the valley, and washed out a part of the Oregon Short Line Ry. The dam was of masonry and cost $50,000. It was built by Hyde & Jackson, of New York, to form a reservoir covering 500 acres. The cause of the accident is said to have been the heavy floods caused by melting snow owing to the mild weather.

A highway bridge over the canal at Excello, O., near Middletown, O., gave way under a team on March 12.

A crossing collision of electric and steam cars occurred at Cincinnati, O., March 14. A westward accommodation train on the Cincinnati, Hamilton & Dayton R. R. struck a Fairmount electric car at the Queen City Ave. crossing. The car was upset, but nobody was seriously hurt. The motorman is said not to have heeded the engine whistle.

The Massachusetts automatic coupler law of 1886 has just been repealed. It had practically become inoperative by reason of the general adoption of the M. C. B. coupler by all railways and also on account of the Congressional action in the matter of railway safety appliances. A law has also been passed at this session requiring the blocking of frogs, switches and guard rails to prevent employees getting caught therein, the method used to be approved by the Railroad Commission.

The New York Chamber of Commerce rapid transit bill is introduced into the State Legislature as an amendment to the law of 1891, providing for rapid transit in cities of over 1,000,000 inhabitants. The new bill provides for a new board of rapid transit commissioners, made up of the Mayor, Controller, President of the Chamber of Commerce, ex-officio, and Samuel D. Babcock, Seth Low, John Claflin and Alexander E. Orr. The powers of the present commission are retained by the new commission which would also have the right to provide for the construction and operation of rapid transit roads for and on account of the city, if the commissioners deemed this desirable. If the board thinks it expedient, it may build a road, or roads at the expense of the city, on any plan legally approved by the authorities and abutting property-owners, and may advertise for proposals for building and operating the road. The successful bidder must construct, equip and operate the road for not less than 35 nor more than 50 years, at an annual rental equal to or not less than the interest on the cost plus not less than 1% on the amount of said cost. A deposit of $1,000,000 is demanded together with satisfactory sureties. To pay for such construction the city is authorized to issue bonds to the amount of $50,000,000, and the road immediately upon completion becomes the property of the city, though the equipment belongs to the operator.

A 10-in. Harveyized plate, 8 × 10 ft., and made by the new plant of the Carnegie works, was tested at Indian Head on March 10. Holes had been made near the edges to test the effect of rivet holes on the strength of the plate, and a weak spot was left near the upper edge to represent a port hole. The range was 100 yds. and a Carpenter 8-in. shell was first used. This struck the plate 16 ins. from the top and one side with a velocity of 1,841 ft. per second. The point of the shell was welded in the plate, the fragments scattered and two slight cracks appeared. The second shot was an 8-in. Holtzer shell with a velocity of 2,000 ft. per second. This shot struck near the upper edge; the point was again welded and the shell shattered, and two cracks were made; one passing from the point of contact to the bottom, and the other to the top of the plate. As before, the cracks did not touch the rivet holes. The third shot was a 10-in. cast steel projectile, with a velocity of 1,500 ft. per second. This broke the plate, lifting the upper part over the oak backing. The naval experts considered the tests satisfactory and proving the merits of the Harvey plate, as they say either of the first two shots would have smashed a nickle-steel plate. The experiment with the rivet holes was particularly satisfactory.

Some cement briquettes recently tested by Mr. C. B. Marriott are reported to us as showing an unusual ability to carry sand in the cement tested (Alsen's Portland). The results were as follows:

Neat cement, 7 days old, 750 lbs. per sq. in., tensile strength.

1 cement to 2 sand, 7 days old, 337 lbs. per sq. in. tensile strength.

1 cement to 3 sand, 7 days old, 238 lbs. per sq. in. tensile strength.

1 cement to 2 sand, 7 days old, 1,025+ lbs. per sq. in. crushing strength.

1 cement to 3 sand, 7 days old, 700 lbs. per sq. in. crushing strength.

In the next to the last test reported, the capacity of the machine was reached without crushing the briquette.

More recent tests of the same cement by Booth, Garrett & Blair, of Philadelphia, gave the following results:

Fineness.

99.7%	passes	No.	50	sieve.	2,500	meshes	per sq. in.
95.1%	"	"	74	"	5,476	"	" "
92.4%	"	"	100	"	10,000	"	" "
68.4%	"	"	200	"	40,000	"	" "

Setting.—Initial set, 1 hour 40 minutes. Final set, 5 hours 10 minutes.

Swelling and Blowing.—Pat set in air, 3 hours in steam vapor, and 10 hours in water at 180° F. Good.

Tensile Tests (briquettes 7 days old).—Neat cement gave 915 lbs. as average of five tests in which minimum was 830 lbs., and maximum was 940 lbs. Briquettes of 3 sand to 1 cement gave 334 lbs. as average of five tests in which the minimum was 328 lbs., and the maximum was 340 lbs.

Railway grade crossings in Brockton, Mass., are to be removed, according to the decision of the Grade Crossing Commission. The railroad will be elevated through the thickly settled district and will cross over the principal streets on substantial arch bridges of masonry. In connection with the improvement two new depots will be built. The plans for the work were prepared by George S. Morrill, M. Am. Soc. C. E., Chief Engineer of the Old Colony Division of the New York, New Haven & Hartford R. R., acting for the railroad company, and F. Herbert Snow, City Engineer, with Geo. A. Kimball, M. Am. Soc. C. E., of Boston, as Consulting Engineer for the city. It is said that the whole work will cost about $1,500,000.

The preliminary trial of the battleship "Indiana" is a success, 15.6 knots having been made with moderate forced draft. The "Indiana" left the Cramp ship yard in Philadelphia on March 6 for a contractor's test over a sea course off Cape May. She was put six times over the course, 9.55 nautical miles in length, making the turns at full speed, and was practically under full speed for five continuous hours. With natural draft the average speed was 14.02 and 14.12 knots, respectively, with an average of 122 revolutions. With ½-in. air pressure, an average of 15 knots was made on the third run, or the speed called for in the contract; with 1-in. air pressure and 125 revolutions the ship made 15.6 knots, with very little vibration. Considering that the bottom has not been painted for a year and that she draws 3 ft. less water than she will with side armor, turrets and guns aboard, this run was considered very satisfactory, and a 16-knot speed is expected on the official trial. The "Indiana" is a 10,200-ton steel coast-line battleship; 348 ft. long, 69¼ ft. beam, 24 ft. draft and 9,000 I. HP.. The contract price was $3,020,000, and Wm. Cramp & Sons were the builders. Her main battery will consist of four 13-in. breech-loading rifles, with a secondary battery of twenty 6 pdr. and six 1 pdr. rapid-fire guns. The sides are to carry 18-in. armor, with 15 and 6-in. armor on turrets, and 17.8-in. and 6-in. armor on barbettes.

THE THIRD AVENUE CABLE RAILWAY, NEW YORK CITY.

IV.

(With inset.)

The principal features of the track and wheel vault construction of the Third Ave. cable railway were described and illustrated in our issues of Dec. 13 and 20, 1890, and Feb. 1 and 22, and March 8, 1894. On our inset sheet this week we show the general arrangement of the cable driving machinery at the two power stations, from which the seven cables are operated.

Power Stations.—There are two power stations, one at Sixty-fifth St. and the other at Bayard St., on the Bowery. The Sixty-fifth St. station occupies the block bounded by Sixty-sixth and Sixty-fifth Sts. on the north and south and Second and Third Aves. on the east and west. This is the main station and from it are driven the four cables of the Harlem and middle divisions of the road. The three cables of the City Hall division are driven from the Bayard St. station. The engine and boiler-room of the main station is 200 × 285 ft. The roof of the engine-room is 84 ft. above the floor and is supported by seven arched steel girders with a clear space of 137 ft. 10 ins.

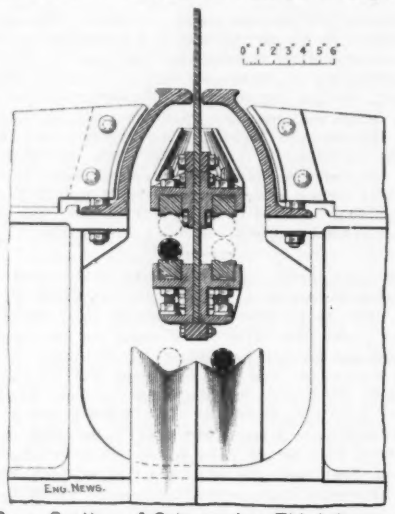
The general arrangement of the engine-room is shown on our inset sheet, the boiler-room being omitted. There are 32 125-HP. return tubular boilers arranged in four batteries. The water and steam connections of the four batteries of boilers are so arranged that they can be worked independently or together, so that either battery will supply steam to any of the four engines. There are four feedwater heaters of 1,000 HP. each and two duplex pumps. The coal bunkers are located on the floor above the boilers and from them the coal is delivered to each furnace by a chute in which it is automatically weighed.

There are four 1,500-HP. Corliss engines, two of which are coupled to the ends of the main shaft by a crank disk and have 22-ft. flywheels. The other two engines are coupled to auxiliary shafts 56 ft. to the rear of the main shaft and transmit their power to the main shaft by means of 22 cotton ropes working over grooved pulleys 22 ft. in diameter. The main shaft is 154 ft. long and 20 ins. in diameter at the wheel hub, and is divided by five plate couplings. Four 9-ft. rope pinions are mounted loose on the main shaft and are provided with plate clutches by which they are coupled to the shaft. These clutches are operated by means of a lever provided with a hand wheel and operated by a rack and pinion. The power is transmitted from these pinions to 32-ft. pulleys mounted on the first winding drum shaft, by cotton ropes. The first winding drum shaft is 50 ft. from the main shaft and is coupled to the second winding drum shaft by a gearing. Both winding drums are thus driven. The winding drums are 15 ft. in diameter and have solid removable rims. With the engines running at 65 revolutions per minute the cables are driven at a speed of ten miles per hour.

The tension runs are 225 ft. long and are located between the winding drums and the street. After being led over the sheaves of the tension carriage the rope returns to a 20-ft. sheave located in front of the winders, from which it is led to the main vault. All the bearings of the driving machinery rest on heavy cast iron bed frames anchored to the brick masonry foundations. In addition to the regular rope-driving machinery, there are two small vertical engines for driving the winding drums at a slow speed for rope inspection or when it is necessary to grind down the grooves. These are located in front of the drums on each side of the building and communicate their power to the drum shafts by gearing. There is also an electric traveling bridge crane of 134 ft. 9 ins. span in the engine-room. The electric current for this crane, as well as that used for lighting, is furnished by an independent engine and dynamo.

The power equipment of the Bayard St. station consists of 16 boilers and two engines, operating three ropes. As the corresponding parts of this machinery are duplicates of those at the Sixty-fifth St. station they will not be described. The engines and winding machinery are located in the basement of the station 36 ft. below the street, but the boilers are located on the first floor on the opposite side of the building. The tension run is located between the winders. A plan and elevation of the engines and winding machinery is shown on our inset sheet. The upper floors of the station building, which is to be nine stories high, will be rented for business purposes.

Rolling Stock.—The rolling stock consists of open cars for the summer traffic and closed cars for the winter traffic. The closed cars are 30 ft. long over



Cross Section of Grip used on Third Avenue Cable Ry.

all, with bodies 22 ft. long and hoods supported on pipe posts. The interior finish is of mahogany, with ceilings of birds eye maple, and door panels of the same material. The seat cushions are of dark red plush. The Pintsch gas system of lighting is employed, and there are three domes in the ceilings in which are placed four-burner chandeliers inclosed in glass globes and supported by bronze brackets. The cars are so brilliantly lighted that there is no difficulty in reading a paper in any part. Four oil lamps, for emergencies, complete the interior equipment of the car. The deck lights are in two tiers, the lower or stationary portion being of stained glass composed of small triangular pieces set in lead, while the upper or ventilator portion is glazed with colored cathedral glass. There are seven windows of French plate glass on each side, and shutters of mahogany with basswood slats. The exterior of the car is unusually handsome, the main panels and dashboards being painted in bright red with silver ornaments and gold lettering, while the lower panel is in white. The hand rails and metal trimmings are of bronze, while the iron platform gates are of the folding type, and painted red.

The grips and brakes are operated by straight levers from either end of the car. The life guards consist of V-shaped fenders faced with rubber, with a wire screen on both sides of the trucks. The trucks were designed and manufactured by the Baltimore Car Wheel Works, and have the Third Ave. standard, oiltight axle boxes.

Details of one of the grips are shown in the accompanying cut. The grip is operated by levers from the car platforms, and is of the movable lower jaw type, this type being considered easiest on the cable besides having several other advantages. Each grip is provided with an automatic device for tripping the cable, which is operated in case the gripman fails to trip the rope at a crossing or at other points where it is necessary.

The principal Cuban iron ore mines are situated on the southeastern coast, between Santiago and Guantanamo. American capital to the amount of $12,000,000 is invested here in three companies, not including other millions invested in ships for transporting the ore. In 1892, 341,050 tons of ore were shipped from Santiago: and in the first six months of 1893, 273,000 tons were sent to the United States. This ore yields from 60 to 67% of pig iron, and is particularly free from foreign substances difficult to handle. Manganese, in unlimited quantity, is found near Manzarrillo, and 18,851 tons were shipped here in 1892; and 11,640 tons in the first half of 1893. Here again American capital is largely invested.

NOTES FROM RECENT WATER-WORKS REPORTS.

Those interested in statistics of water consumption will find in the last annual report of the Montreal water-works a table giving by months and for each year the average daily consumption for the 34 years 1859 to 1892, inclusive. In 1859 the consumption was 3,250,000 and in 1892, 14,479,384 gallons. Metered water in 1892 yielded an average revenue, including meter rents, of 19⅞ cts. per 1,000 gallons, and unmetered water, excluding that furnished free of charge, 13½ cts. It is estimated that in the winter about 30% of the total amount pumped is wasted by negligence. Mr. A. Davis is superintendent.

The water consumption at Fall River, Mass., during 1893 was 28.81 gallons per day for each consumer, or 26.59 gallons per inhabitant, about 90% of the inhabitants using water. This low consumption can be accounted for only by the fact that nearly 80% of the services are metered, 4,529 of a total of 5,793. During the year 267 new services and 384 new meters were added. Mr. P. Kieran is superintendent.

About 70 of the services in use on Dec. 31, 1893, at Providence, R. I., were metered, an unusually large proportion for so large a city, the population in 1890 having been 132,146. Mr. Edmund B. Weston, M. Am. Soc. C. E., is engineer in charge of the water department.

The Salem Water Board has recently issued an illustrated special report of over 40 pages on an additional water supply, which includes engineers' reports by Messrs. Walter H. Sears and Lucian A. Taylor, M. Am. Soc. C. E. Mr. Sears made a hydrographic survey of the lake from the ice in December, 1892, and January, 1893, taking 870 soundings on 100-ft. cross-sections. A 1½-in. auger was used to bore the holes through the ice and the line was graduated after being thoroughly wet and compared during the work with a steel tape.

Lead-lined iron service pipe made by the New Water Pipe Co., Wakefield, Mass., is now used for all services at Pawtucket, R. I. Mr. Edwin Darling, Superintendent, states:

> We have had experience with it for the past two years and believe it to be safe and responsible. It practically makes a lead service, and at one-half the cost of lead pipe, which under our pressure, causes expansion and leakage.

This kind of service pipe was described and illustrated in Engineering News of Dec. 22, 1892.

The advantages of a combination of water and electric lighting plants are now being enjoyed by a number of communities. A report on such a plant for the village of St. Bernard, O., was made in January, 1894, by Mr. Geo. Hornung, M. Am. Soc. M. E., Cincinnati, O. The estimated cost of such a combined plant is $76,865 with, and $73,535 without, a stand-pipe. The supply would be from driven wells. There would be two 6½ × 16-ft. steel boilers, four 8-in. deep-well pumps and two 500,000-gallon horizontal duplex pumping engines; a 150-HP. engine, one 30 and one 40-arc light dynamo and one 750-light incandescent alternating dynamo; a 20 × 115-ft. steel stand-pipe, or a 25 × 28-ft. elevated tank, with 7½ miles of 10 to 3-in. pipe and 49 double hydrants; 9½ miles of arc and 8 miles of incandescent circuit, with 66 arc lamps of 2,000 c. p.

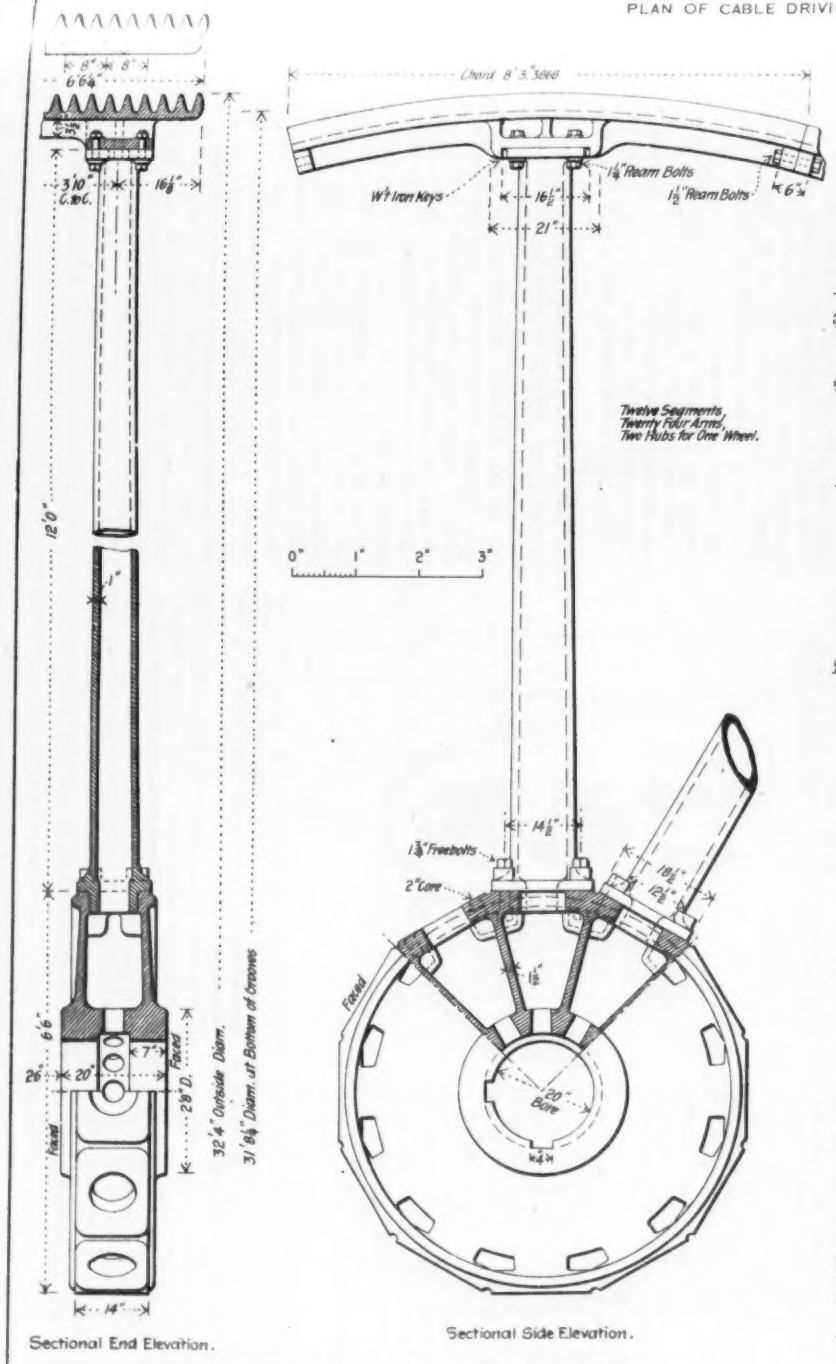
Reports on an increased water supply for Holyoke, Mass. have been made recently by Messrs. W. E. McClintock, M. Am. Soc. C. E., and Jas. L. Tighe. The latest plan is outlined by Mr. Tighe and approved by Mr. McClintock and proposes a 20 or 24-in. cast iron supply main 60,000 ft. in length.

Observations on the waste of water at Philadelphia were continued during the year 1892 (see Eng. News, Oct. 27, 1892, for account of the observations in 1891), and the results are given in an interesting and forcible manner in the last published report of the Bureau of Water, of which Mr. Jno. Ogden is chief. The studies of waste were made by Mr. A. J. Fuller, Assistant Engineer in Charge of Distribution.

No printed reports of the works at Battle Creek, Mich., having been issued in previous years, a condensed statement for the

66th Street

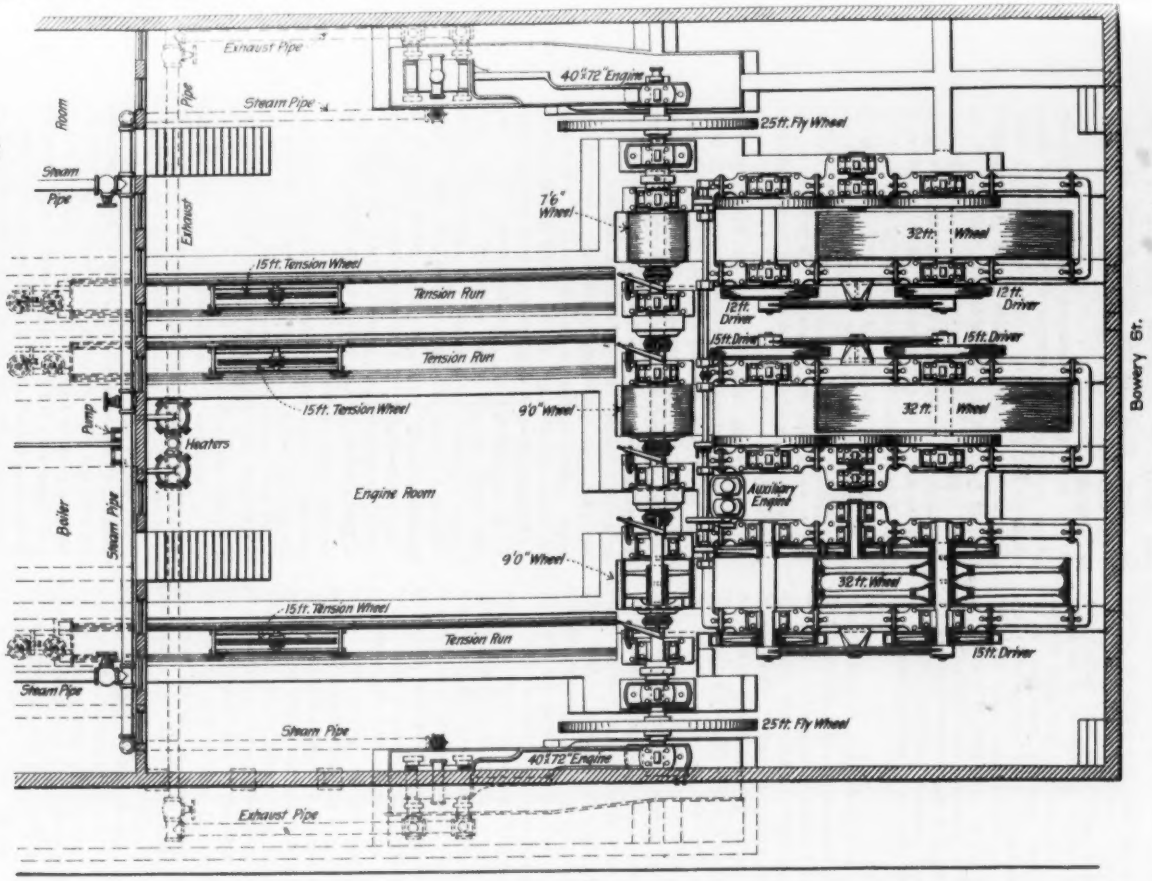
PLAN OF CABLE DRIVING MACHINERY AT SIXTY-FIFTH ST. POWER STATION.



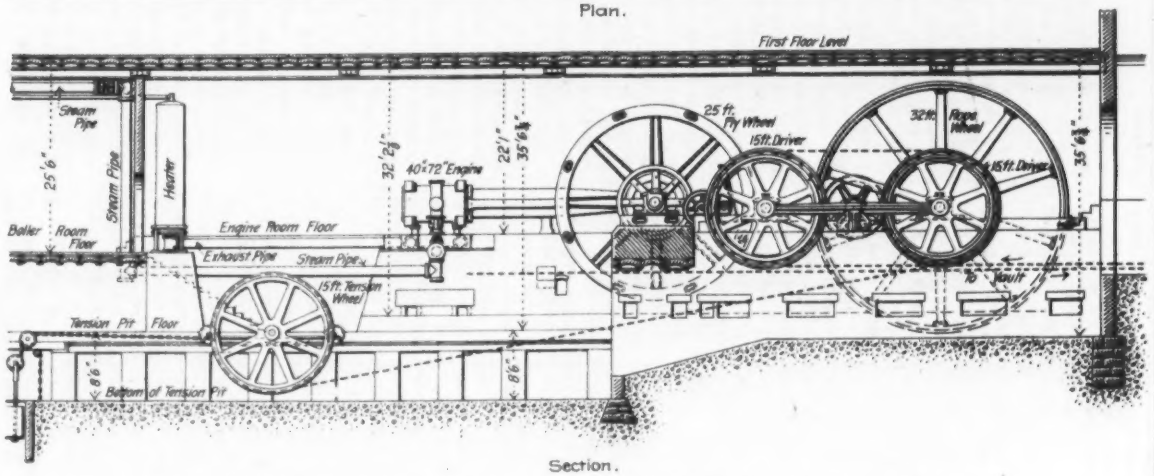
Sectional End Elevation.

Sectional Side Elevation.

DETAILS OF 32 FT. PULLEY FOR ROPE TRANSMISSION.



Plan.



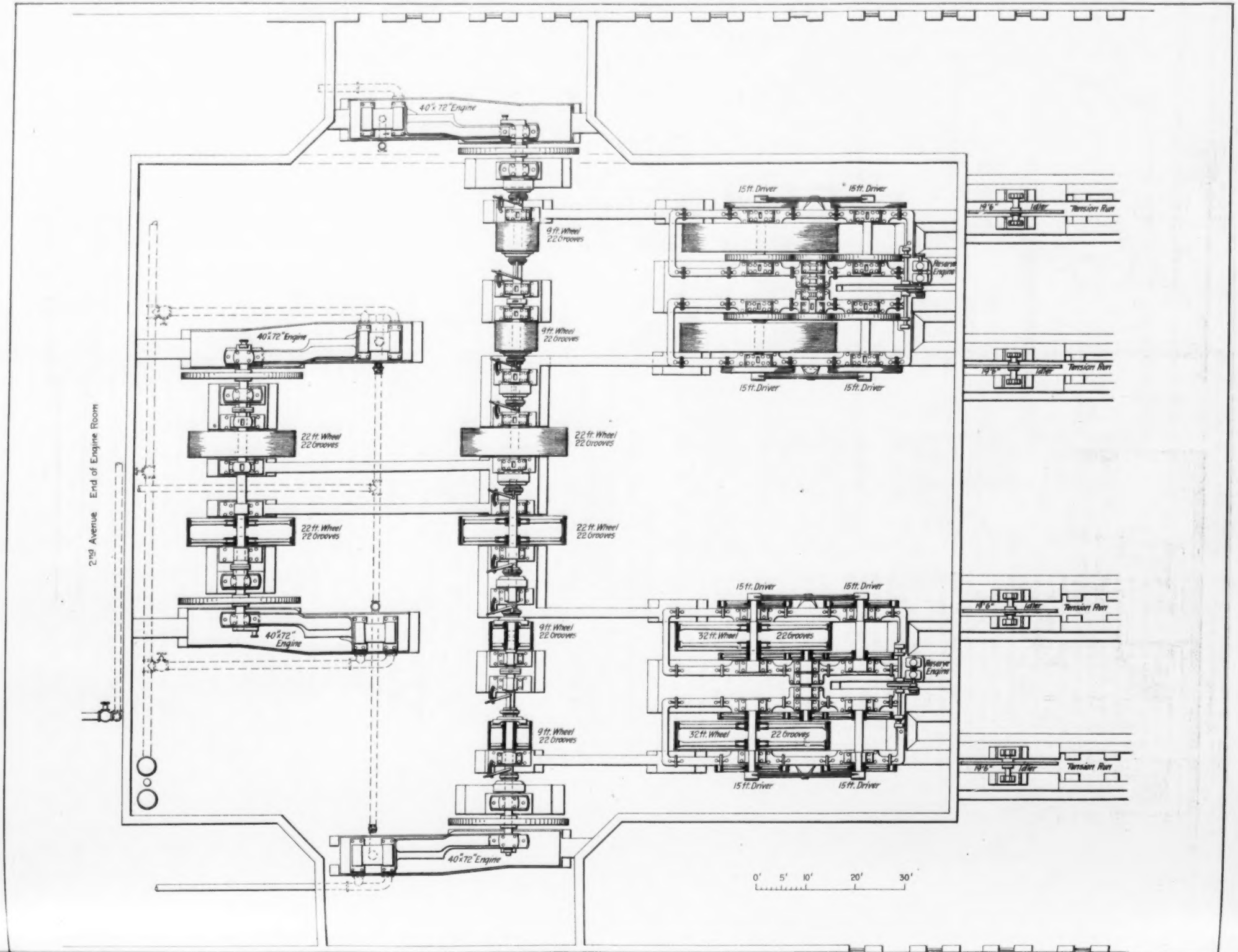
Section.

PLAN AND SECTION OF CABLE DRIVING MACHINERY AT BAYARD ST. POWER STATION.

THIRD AVENUE CABLE RAILWAY, NEW YORK CITY; CABLE DRIVING MACHINERY.

J. H. Robertson, Superintendent. A. H. Lighthall, Chief Engineer.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.



PLAN OF CABLE DRIVING MACHINERY AT SIXTY-FIFTH ST. POWER STATION.

five years 1889 to 1893, inclusive, has been made by Mr. W. W. Brigden, Engineer and Superintendent, and printed on one side of a 7¼ × 13-in. sheet, together with more detailed figures for 1893. The information on this sheet is of far greater value than that given in many reports of from 20 to 100 or more pages and is mentioned here as an example and encouragement to other city officials. In 1893 32% of the water used passed through the 48% of the services supplied with meters, the average receipts per 1,000 gallons having been 10 cts. for metered and 4 cts. for unmetered water.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 193.)

Broad Irrigation at North Brookfield, Mass.

A public water supply was introduced in the town of Spencer, Mass., in 1883 by the Spencer Water Co., whose works have since become the property of the town. The population of the whole town in 1890 was 8,747, having increased to this number from 7,466 in 1880; but the village proper has a population of only 3,000 which can ultimately be connected with the present sewer outlet, built in 1893. The sewage is purified by means of broad irrigation and arrives at the disposal area intermittently, as described below. The sewerage system was built with Geo. A. Craig & Son, of Spencer, Mass., as engineers, and Mr. W. E. McClintock, M. Am. Soc. C. E., of Boston, as consulting engineer. Mr. Nathan E. Craig has sent us under date of Feb. 12, 1894, the following description of the screen chamber, flush tank, invert and irrigation areas:

The main industry of the town of Spencer is a large boot factory employing about 1,000 hands. The primary intention of the town was to dispose of the sewage from this factory and at the same time build the main necessary to serve as such for a separate system for the entire village. We could find no suitable land for filtration that could be reached by gravity, but there are about 20 acres of the town farm, shown in plan by Fig. 102, well adapted to broad irrigation, naturally very light and dry and not yielding heavy crops. In order to reach the highest point on this field it was necessary to employ an inverted siphon, shown in profile by Fig. 102. As the outlet sewer has an average grade of about 3% for 3,258 ft., the distance from the village to the flush tank, with no side inlets within 500 ft. of the head of the invert, we decided to use an iron invert and make the sewage force itself to the town lot. By measurement, we found that the sewage from the shop alone is about 8,000 gallons per day. As yet there are but few side connections. The ground soakage into the sewer last summer was about 2,500 gallons, increasing during wet weather to about 5,000 gallons, so that at present there is a discharge of about 13,000 gallons per day. The town was desirous of building a cumulative system, expending a certain sum each year, and the idfficulty which presented itself to us was to build a gravity main and invert large enough for the ultimate maximum use and at the same time guard against any liability to stoppage in the invert owing to the sluggish flow at the start.

To overcome this, we decided to use an automatic flush tank at the head of the invert with screen chamber auxiliary, both shown by Fig. 103, of sufficient size to retain and automatically discharge in a short time more than sufficient to replace the amount standing in the invert and thereby obviate any danger from stagnation therein. The invert holds about 5,700 gallons. Each discharge of the flush tank, which takes about 24 minutes, discharges about 6,300 gallons, which is more than the tank itself holds, but there is back water in the screen chamber and gravity main at the time of each discharge. The iron pipe extends 170 ft. back of the line where the sewage stands when not flowing in the invert.

There is a 6-in. vertical air pipe at station 1,410 to allow the air to escape from the pipe when the siphon discharges.

We did not have things in working order until November and therefore have not our irrigation area fully prepared. The warden of the town farm has ploughed furrows about 3 ft. apart, following somewhat closely the contour of the ground, over about 1½ acres of the knoll lying southeasterly of the end of the 8-in. outlet pipe, Fig. 102. He has also made two long furrows extending westerly from the gate box, shown at contour elevation 795, Fig. 102, and occasionally diverts the sewage therein. It is the intention to use the lower part of the field as much as possible in warm weather, thereby decreasing the liability of complaint from the occupants of the farm buildings at the north of the road. In the spring a pipe will probably be laid from the end of the 8-in. pipe to the 3½-acre lot at the south, Fig. 102.

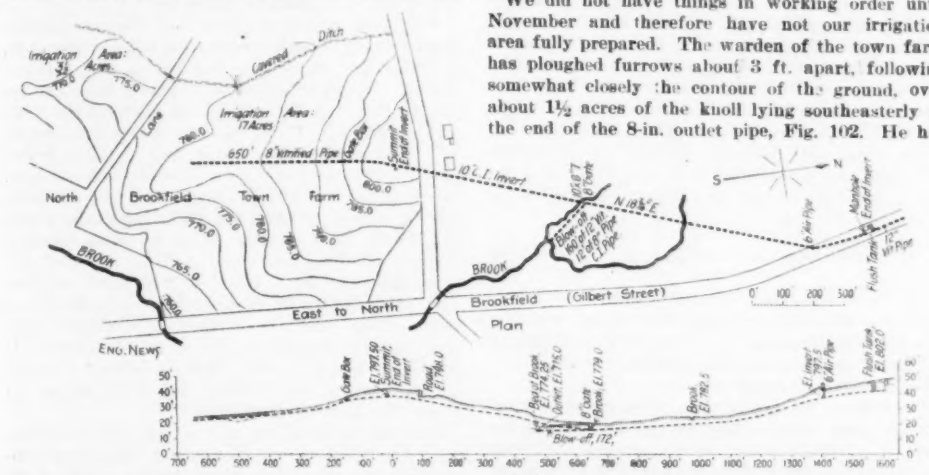


FIG. 102. PLAN OF SEWERAGE IRRIGATION AREA AND PROFILE OF OUTLET, NORTH BROOKFIELD, MASS.

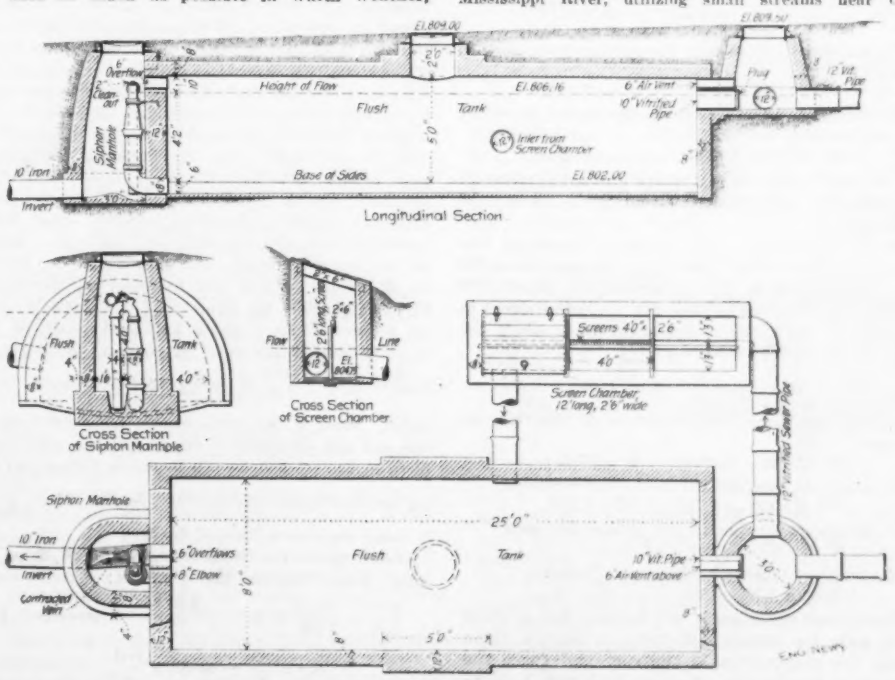


FIG. 103. DETAILS OF SEWAGE SCREEN, FLUSH TANK AND SIPHON, NORTH BROOKFIELD, MASS.

From the operation of the plant thus far we are of the opinion that although we can get excellent results when the frost is out of the ground, yet in winter the results will not be entirely satisfactory until we have enough of the village covered with laterals so that the discharges shall not be more than two or three hours apart. An application of 6,300 gallons and then a rest of twelve hours before another discharge will not take out the frost, but as there are no buildings near the brook shown southeast of the lot for at least a mile, and its volume in winter is considerable, we think that whatever overflow there is from the town lot therein will not create a nuisance.

The length of main sewer laid in the system to date is 7,852 ft., of which 6,258 ft. is 12-in. vitrified pipe and 1,594 ft. 10-in. cast iron pipe. In addition to this, there are 160 ft. of 12-in. vitrified pipe and 12 ft. of 8-in. cast iron pipe in the blow-off to the invert and 650 ft. of 8-in. vitrified pipe in the town lot, making the total length constructed to date 8,674 ft. The total cost of the system, including flush tank, screen chamber and all labor necessary in preparing the town lot, has been $9,700. The consulting engineer was Mr. W. E. McClintock, M. Am. Soc. C. E., of Boston, and we would also acknowledge valuable aid furnished by Mr. A. F. Noyes, M. Am. Soc. C. E., Chief Assistant Engineer of the Massachusetts State Board of Health.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Liability of Municipal Corporations for Defective Streets.

The law does not require towns to make their roads passable over their entire width. Their duty is fully performed when they have prepared carriage ways of sufficient width to make them reasonably safe and convenient for travelers who drive over them with reasonable care. When one intentionally, heedlessly and unnecessarily drives out of the wrought part of the road, he does so at his own risk.—Tasker v. Inhabitants of Farmingdale, Sup. Jud. Crt. of Maine, 27 At. Rep., 364.

Liability of Contractor in Construction of Sewer.

Contractors, in constructing a sewer for a city, have no right to go beyond the lines of the street on which the sewer is being constructed, and deposit earth on a lot abutting on such street, without having first the damages assessed and paid or tendered to the owner. The contractors, and not the city, are liable in such case to the abutting owner for the injury to his property.—Kinser v. Dewitt, Appellate Court, Ind., 34 N. E. Rep., 1014.

A canal bill is before Congress asking for authority to survey a canal route connecting Lake Superior with the Mississippi River, utilizing small streams near the source of the river. The proposed canal would be 120 ft. wide and 20 ft. deep, and Duluth capital is claimed to be ready to embark in the construction.

A METHOD FOR CALCULATING THE STRESSES IN THE FERRIS WHEEL.

By J. W. Schaub, M. Am. Soc. C. E.

In one of the recent engineering publications* there appeared a paper, with discussions, on the Ferris wheel, in which there were many conjectures as to the probable stresses which may occur in such a structure. Considering the interest attaching to this question it was a great disappointment that the subject was not handled more scientifically. For some time engineers have been waiting for a paper from the designer of the wheel, giving a full description of its design, but it does not appear that such a paper is forthcoming. We shall therefore have to content ourselves with what we can find out by our own observations. The writer has worked out a brief analysis of the stresses in a wheel; and with the hope that by its publication more detailed information may be brought out, he presents this analysis herewith.

A wheel of any convenient diameter supported on a horizontal shaft has a rim composed of 36 segments, as shown by the accompanying cut. The sides of these segments are assumed to be straight lines. There are 36 loads W supported by the rim. For the sake of simplicity, it is assumed that no deformation occurs in the wheel. Then by statics, the maximum compression in the

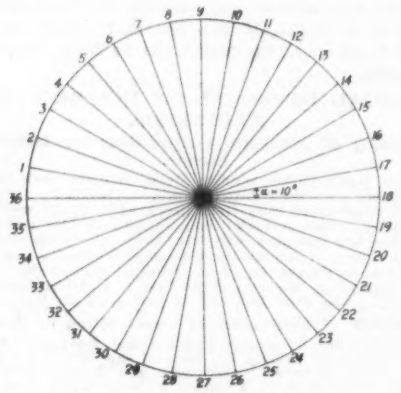


Diagram of the Ferris Wheel.

rim of the wheel at 27, and the maximum tension in the rim at 9 is found to be

$$W(\sin\alpha + \sin 2\alpha + \sin 3\alpha + \ldots + \sin 8\alpha + \tfrac{1}{2}) \times \sec\frac{\alpha}{2} = W \times 5.737.$$

The maximum tension in the spokes occurs at 27, and is

$$W(5.737 + 11.474) = W \times 17.211.$$

The maximum compression in the spokes occurs at 9, and is again

$$W + 2W \times 5.737 \times \sin\tfrac{1}{2}\alpha = 2W.$$

It is evident that the stresses are independent of the diameter of the wheel, assuming the loads to be constant.

If the spokes are rods, capable of resisting tension only, it is evident that each rod must be under an initial stress of 2W; otherwise the wheel will collapse at the crown. Let 2W = initial stress in each rod. Then, the compression produced in the rim by this initial stress in each rod will be

$$W \times \operatorname{cosec}\frac{\alpha}{2} = W \times 11.474$$

The total maximum compression in the rim then becomes

$$W(5.737 \times 11.474) = W \times 17.211.$$

The minimum compression in the rim becomes

$$W(11.474 - 5.737) = W \times 5.737.$$

The maximum tension in the spokes becomes

$$W + 2W \times 17.211 \times \sin\tfrac{1}{2}\alpha = 4W.$$

The minimum tension in the spokes becomes

$$2W \times 5.737 \times \sin\tfrac{1}{2}\alpha - W = 0$$

From these equations it will be seen that a wheel with rods for spokes will have to sustain three times the compression in the rim, and twice the tension in the spokes, that a wheel will have to sustain which is built with stiff spokes; that is, with spokes capable of resisting both tension and compression.

* "Journal of the Association of Engineering Societies," December, 1893, paper by Wm. H. Searles before Civil Engineers' Club of Cleveland.

A NEW FORMULA FOR BENDING STRESS.

By Henry Szlapka.

Some time ago attention was called in Engineering News to the desirability of extending the use of fireproof construction in connection with the burning of Purdue University's physical laboratory building. In another article Mr. Kindl discussed the relative cost of fireproof vs. wooden construction. While not always the largest single item in a fireproof building, the beam work still forms such an important part in the total that any considerable saving in its cost would be a great inducement to the widespread use of this desirable form of construction. The cost per pound of steel beams has lately dropped to such a figure that any further lowering cannot be expected for a long time to come, while the theoretical utilization of the material in present shapes leaves little to be desired. It is rather in the matter of being able to safely allow a greatly increased extreme fiber strain in shapes subject to bending, that we must look for improvement. In a paper read before the French Society of Civil Engineers in December, 1889, M. L. Rey has shown that the formula in present use for determining sizes of pieces subject to bending is entirely contradicted by experiments and has deduced on the basis of a most reasonable hypothesis another formula agreeing well with experiments. Since the writer has never seen the subject mentioned in American technical papers, he believes it will be of great interest to briefly present the matter to engineers for their consideration.

The usual formula for bending is $M = \frac{S\,I}{d}$, in which

M = bending moment in inch-pounds.

S = the allowable extreme fiber strain, which is taken to be the same as if the piece was subject to simple extension or compression.

I = moment of inertia.

d = distance of neutral axis from extreme fiber.

While this formula has always been used, for want of anything better, most engineers have long had an inkling that it did not correspond with actual facts, and that S could safely be used higher than in a case of pure tension or compression (the formula, of course, applies to the elastic limit only). Pins in bridges have notoriously stood fiber strains far in excess of the formula without showing the least permanent set. While it may be said that by the deflection of the pin the distribution of strain among the eyebars may be altered so as to prevent undue strains, still this explanation cannot always account for the large difference between theory and practice without leaving the fact unexplained why the eyebars themselves did not show permanent set. In some cases, like that of a steel spring of rectangular section, it may even happen that the limit of elasticity of flexure as deduced by the usual formula is considerably higher than the breaking strength of pure tension. The hypothesis mentioned consists in assuming that it is necessary to expend the same amount of work to obtain an infinitely small deformation between two infinitely near sections, whether we act by pure tension or compression, by flexure or by torsion. From any textbook on mechanics, say, Weisbach's, we know that the work W done by a force F to elongate an elastic body of the area "a" and length equal to unity, up to the elastic limit S_1 is $W = \frac{a\,S^2}{2\,E}$, E being the modulus of elasticity. Now, if the same elastic body be fixed at one end and subjected to bending at the other by a force F, the work done can be easily deduced as being (see Merriman's Mechanics, "Key"): $W_1 = \frac{S_1^2\,I}{2\,E\,d}$

S_1 being the elastic limit of flexure.

According to the hypothesis, W and W_1 must be equal; hence equating them, we get:

$$\frac{a\,S^2}{2\,E} = \frac{S_1^2\,I}{2\,Ed^2} \text{ or } S_1^2 = \frac{a\,d^2\,S^2}{I}; \text{ or since } r^2 = I$$

$$S_1^2 = \frac{d^2}{r^2}\,S^2 \text{ or } S_1 = \frac{S\,d}{r},$$

which means that if a body may be strained by the amount S for each unit of its section in direct tension or compression, the strain per unit of extreme fiber of the same body subject to flexure may be taken as S_1. A similar formula may be deduced for torsion. Calling the ratio $\frac{S_1}{S}$ k_f we have $k_f = \frac{d}{r}$. From this we see that the smaller the radius of gyration r of a section, the larger will be the ratio k_f. It follows that the section having most of its material concentrated near the neutral axis will give the largest k_f; that is, the case of a lozenge. On the contrary, the section having most of its material concentrated as far away from the neutral axis as possible will give the smallest ratio; that is the case with plate or lattice girders.

For the lozenge $k_f = \sqrt{6} = 2.45$.

" circle $k_f = 2.00$.

" rectangle $k_f = \sqrt{3} = 1.732$.

" triangle (base parallel to the axis of flexure) $k_f = 2\sqrt{2} = 2.828$.

For the ellipse $k_f = 2.00$.

For a ring $k_f = \frac{2}{1 + m^2}$, where $m = \frac{d'}{d}$; d' being the inside, d the outside, diameter.

For the Carnegie shapes of steel I-beams (pocket-book, edition 1893) k_f varies from 1.27 for the 24-in. I, 240 lbs. per yd., to $k_f = 1.24$ for the 3-in. I, 18 lbs. per yd. For steel channels it varies from 1.46 for the 15 ins., 165 lbs. per yd. to 1.30 for the 3-in., 15 lbs. per yd. From this we see that in beams we could safely allow from 24% to 27% higher extreme fiber strains than at present with an equal factor of safety. The deflection, however, not being directly dependent on the extreme fiber strain, would still govern as at present, where a certain specified amount of deflection could not be exceeded for structural reasons. But as the sizes are not very often limited by considerations of deflection, a great saving might be effected in structural ironwork by the adoption of the above hypothesis. It would be indeed worth while to conduct a series of experiments on I-beams and other shapes to verify the above deductions.

Till that is done we may accept the hypothesis provisionally on its own merits, as it appears reasonable on its face, and on the following series of experiments mentioned by M. L. Rey in his paper. As stated already, the conviction has for a long time been gaining ground that there was something wrong in our usual formula, but that for want of anything better the formula has been retained.

Application of the New Formula to Different Practical Cases.—I. Flat Saw Band.—A saw band about 1-32 in. thick, made of steel of 237,600 lbs. per sq. in. ultimate strength, and of 156,500 to 170,800 lbs. elastic limit, was rolled on a cylinder 5⅞ in. diameter without indicating permanent set. Rolled on a cylinder 5⅛ in. dia. it showed a noticeable permanent set. In the former case the extreme fiber stood 256,100 lbs. per sq. in., and in the latter 296,000 lbs., according to usual formulas. But modified by the above ratio of 1.732 for rectangular section, the extreme fiber strains are from 153,700 to 170,800 lbs., values very near to the actual limit of elasticity of the steel.

II. Flat Spring.—The flat springs made for French railroad use are of steel showing an ultimate strength of 142,300 to 149,400 lbs. per sq. in. for tension, and an elastic limit of 99,600 to 106,700 lbs. with E = 40,000,000. These springs have been tested by loads producing an extension of from 0.5% to 0.6% of the extreme fiber, according to usual formula, thus working without permanent set under strains of 142,300 to 170,800 lbs. per sq. in., values far in excess of the elastic limit. Modified as in the preceding example, we find that the extreme fibers work at 82,500 to 98,200 lbs., which are very near the experimental values for the limit of elasticity.

III. Steel Rail of the Paris, Lyons & Mediterranean R. R.—The rails of this company weigh 71 lbs. per yd. and are made of steel, which, from 62 experiments, has been found to stand 102,500 lbs. ultimate, with an elastic limit of 49,800 lbs. These rails have been tested by 60,000 lbs., applied at the center of a span of 39 ins. Figuring in the usual way, the extreme fiber would then be strained 65,500 lbs. per sq. in., quite above the elastic limit, while our new formula gives 44,700 lbs. fiber strain, thus coming remarkably close to actual facts. Under this load a certain number of rails showed no permanent set; others retained a set of from 1-128 in. to 1-64 in., thus showing that they were strained just about to the elastic limit.

IV. Coupling Hook.—A coupling hook of the standard French type, made of iron, giving test values of 61,200 lbs. per sq. in. ultimate, should stand a pull of 30,000 lbs. within the elastic limit, and should not break at

less than 64,000 lbs. With the former pull the strain per sq. in., according to the usual formula, would be 40,300, an impossible value; while with the proper modification we get 25,600, a little below the limit of elasticity. Taking the sections and lever arms at the moment of breaking, the usual method gives an ultimate strain of 96,800 lbs. per sq. in., while Mr. Rey finds 61,200 by his method the actual ultimate value.

V. Safety Chain.—Made of first-class iron (54,100 lbs. ult.), a standard link must support a pull of 12,000 lbs. without permanent set, and must not break at less than 30,000 lbs. With 12,000 lbs. pull the usual formulas give 34,200 lbs., much above the elastic limit; the modified value is 21,400 lbs., coming very close to the actual elastic limit of the iron.

VI. Spiral Spring.—A spiral spring of rectangular section, 4¾ × 9-32 in., with the largest radius at the base of 3 1-16 in., should take without permanent set a load of 4,400 lbs., being made of the same material as Case II. According to usual assumptions the extreme fibers would then be strained up to 145,200 lbs. per sq. in., which is altogether above the elastic limit. Applying the new formula for torsion, the extreme fibers will be strained to 84,000 lbs. per sq. in., a value well within the limit of elasticity of the steel.

THE OWNERSHIP OF SURVEY RECORDS.

In a late issue of the Troy "Polytechnic" Prof. W. S. Raymond answers another writer in the same journal who, in the course of a paper, noted that a certain civil engineer discharged his best assistant for keeping a private notebook. This engineer explained his action on the ground that these notes of survey were the private property of the chief; that they were valuable to him as a guide in making future surveys, and hence were decreased in value by duplication. Mr. Raymond suggests the desirability of presenting another side of the question, which he believes is more correct in principle, as follows:

Mr. Raymond believes the young assistant is entirely justified in recalling at night the work of the day and in making notes of it. He does not thus use his employer's time in field or office, and as he gains in experience he becomes more valuable to his employer. In fact, a part of his salary is this experience, which is practically the knowledge he gains of certain methods and of the locality in which he works. If he uses his employer's time, however, in making his notes, he is obviously doing wrong, though he is following an example constantly before him.

The writer says that the question of what constitutes a survey arises at once in this discussion, and the answer must depend on the object of the survey. Surveys for the subdivision of large tracts of land, or surveys intended for establishing the boundaries of a known tract, or for determining a description when the boundaries are known, are alone considered here. The principle enunciated applies, however, to any survey.

A survey is "the operation of finding the contour, dimensions, position or other particulars of any part of the earth's surface . . . tract of land, etc., and representing the same on paper." The setting of corners, or monuments, and their description, become a part of the survey; and the map, together with the notes, should show faithfully the ground, the work done and the items mentioned. The purpose of establishing corners or monuments is to mark on the ground the boundaries of tracts; to plainly define the location with reference to other tracts, and to enable future surveyors to correctly trace these boundaries. The survey is evidently not complete until the corners are fixed, proper information obtained and the same put onto the map and into the notes.

The doing of all this constitutes a survey, and the question now is, to whom does this survey belong? Mr. Raymond believes it belongs to the individual who pays for it; and it is hard to see how the survey or any part of it can become the sole property of the surveyor. The latter may keep notes to facilitate his future work; but he cannot properly claim a single note made in the time paid for by his employer.

If, however, the surveyor takes the work, not on time, but for a definite sum for the entire job, he may take as much time and as many private notes as he likes. But as he is bound in honor to return to his employer the survey complete in every detail, it is not obvious that his private notes would be of great assistance to him in securing further work; especially when it is remembered that professional men of repute do not bid against each other for such work. His reputation for accuracy and honesty will be worth much more than any quantity of private notes.

The record of monuments and street lines made by a city engineer are no more his private property than are the records of the city clerk, auditor or treasurer. Court decisions indicate the correctness of the position here taken, though much laxity is shown in this respect by city engineers and county surveyors. The method of regulating the pay of these offices has doubtless much to do with the practice. Where the surveyor receives no salary, but is allowed to collect certain fees for work performed, there is some color to the claim that his work is private work and belongs to him. That this is not true concerning the public work done by these surveyors and engineers is believed to be evident from what has preceded.

Mr. Raymond believes that in every case these offices should be salaried offices, with such salaried assistants as are necessary. If certain fees are prescribed, these fees should cover all work connected with public construction, or public or private land lines, and these fees should be returned to the public treasury. Their amount may be regulated from time to time so that they shall aggregate a sum sufficient to pay expenses of the office, but they should not cover work of a private character having no connection with land lines. The entire public is interested in the permanency of land lines, and all records connected with them should be public property. These lines are of too important a character to be the subject of jealous rivalry.

For this purpose the returns of every surveyor to an owner should be thoroughly complete; and maps filed should be so finished that any surveyor can relocate the land correctly. Unfortunately, this is now seldom the case, as every surveyor well knows. In some states good laws exist prescribing what shall appear on a map before it is accepted as a public record, but in many more states there is nothing whatever to guide the owner, surveyor, attorney or recorder in such matters. The writer then recounts what is usually found, or rather, not found, in the maps on record, and shows the trouble and costly litigation constantly arising from vague or impossible descriptions of lines, descriptions resulting either from stupidity, or knavery.

While man is fallible and errors will occur, it is possible to reduce these errors in number by proper regulations, and Mr. Raymond suggests the following as tending in this much-wished-for direction:

A map of a city, town, audition, or other tract of land, serving as a basis for the description of property, should furnish all the information necessary to the proper description and location of the various parcels shown, and also of the whole piece. It should further show the exact location of the whole tract to the lands immediately adjoining; particularly should this be done when an offset or angle in a street line occurs. To accomplish these things there should appear on the map the following items:

1. The lengths of all lines shown.
2. The exact angle made by all intersecting lines.
3. The exact position and character of all monuments set, with notes of reference points.
4. The number of each block and lot.
5. The names of all streets, streams or bodies of water, and recognized landmarks.
6. The scale.
7. The direction of the meridian and a note as to whether the true or magnetic meridian is shown—it should be the true meridian.
8. The angles of intersection made by the lines of adjoining property with the boundaries of the tract mapped.
9. The exact amount of offset in lines that may extend from the outside through the tract mapped.
10. A simple, complete and explicit title, including the date and the name of the surveyor.

Thus much to make the map valuable for description and location of the property it represents. Of course monuments will not be shown if none have been set, and very frequently none are set, either from carelessness on the part of the surveyor, or an unwillingness on the part of the owner to pay their cost. Monuments of a permanent character should be set at each corner of a tract surveyed, and at least two, visible the one from the other, on the line of each street. If these monuments are not placed on the center lines of the streets, they should be placed at uniform distances from the center or property lines. If placed with reference to the center line they should all be placed on the same side of the center. In streets extending east and west, the monuments should all be on the north of the center, or they should all be on the south, and at uniform distance. In streets extending north and south the monuments should all be on the east of the center, or all on the west.

Uniformity in such practice saves a vast amount of time. Monuments may be set at uniform distances from the block lines, in the sidewalk area, and this is an excellent practice. The stakes or monuments set at the corners of the blocks in additions, or town sites, should never be the only stakes or monuments set in the tract..

That the map may be reliable there should appear on it the following:

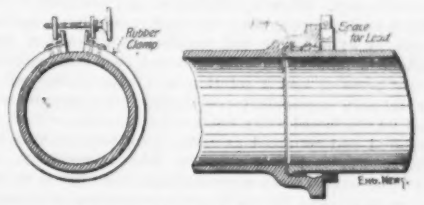
1. The certificate of the surveyor that he has carefully surveyed the land, that the map is a correct representation of the tract, and that he has set monuments (to be described) at the points indicated on the map.
2. The acknowledged signature of all persons possessing title to any of the land shown in the tract, and if possible those of adjoining owners.
3. If of an addition, the acknowledged dedication to public use forever of all areas shown as streets or roads.
4. If a street of full width, whose center line is a boundary of the tract, is shown, the acknowledged signature of the owner of the adjoining property, unless his half of the street has been previously dedicated.

It has been already stated that, in some states, a map may be filed at the request of any person, and without signature. This practice frequently leads to trouble. The writer knows of cases in which owners of large tracts of land have had those tracts subdivided and have taken land of adjoining non-resident owners for street purposes without the consent or knowledge of those owners. When at a later day the owners of the land so taken have objected and attempted to close half of the street, trouble of a serious character has arisen.

The remedy for all the evils pointed out, says Mr. Raymond, lies in the enactment of a law in each state governing these matters; statutes explicitly defining what shall appear on every map filed for reference, and making it a misdemeanor to file maps not strictly conforming to the definition. In the absence of such laws the young surveyor can greatly assist in a much-needed reform by following the principles here laid down; and, as Mr. Raymond well says, this young surveyor can spend his energies to much greater advantage in devising new and better methods of work than in inventing ways for hiding information that really belongs to the man who pays for the survey.

A CLAMP MOLD FOR POURING LEAD JOINTS.

The accompanying sketch of a clamp for pouring lead joints in laying cast iron water pipe was sent us by Mr. Hiram Phillips, St. Louis, Mo., who states that he has used it with success. The device is made of rubber packing and provided with a clamp, as shown in sketch. Before using



A Device for Pouring Lead Joints.

it is given a thin coating of fireclay. A pouring mold on top of the pipe is made by the use of a small piece of fireclay. Mr. Phillips says the device is entirely original with him, but that it is somewhat different from any he has seen in use. He also says that it is inexpensive and is a great improvement over the old method of using a fireclay roll.

The Antwerp International Exposition is to open on May 5 next. All the main buildings are now completed. Intending exhibitors are urged to make application for space immediately to the U. S. Commissioners of the Exposition, whose headquarters are at 14 Church St., New York city.

THE ELECTRICAL PURIFICATION OF WATER.*

By Thomas M. Drown, M. D., Professor of Chemistry, Massachusetts Institute of Technology.

In this electrical age when a new application of electricity to every-day needs is a matter of daily experience, it does not surprise any one to hear of the practical use of electricity as a purifying and disinfecting agent, particularly as we are accustomed to think of it as a force which purifies as well as destroys. The electrical purification of water and sewage appeals to most persons, therefore, as a process likely to be both potent and effective. There is, moreover, to some minds a peculiar satisfaction in the contemplation of a subtle force which acts in a mysterious way, and to such minds an explanation is often an unwelcome disillusion. Inasmuch as considerable prominence has been given in the last decade to methods of electrical purification of water and sewage, it may not be uninteresting to state briefly just how this purification is effected, and the principles on which it rests.

We may distinguish two classes of so-called electrical purification: (1) Those which electrolyze water, liberating oxygen at the positive pole; and (2) those which electrolyze a solution of common salt and liberate chlorine in the same way.**

The Webster process for the purification of sewage, of which a good deal was once heard, belonged mainly to the first class, although by reason of the chlorides contained in the sewage, it fell also, in part, into the second class. The oxygen, liberated at the positive pole, while in the nascent state, was supposed to oxidize some organic matter; but as this pole was composed of iron plates, the oxygen was mainly consumed in oxidizing this iron, and the oxide of iron thus formed acted as a precipitating agent on the sludge in the sewage. The process was, thus, mainly one of chemical precipitation of sewage by means of oxide of iron, which was formed by a current of electricity passing through the sewage. Much was hoped from this process, but it never passed, as far as I am aware, beyond the experimental stage.

The possibility of oxidizing organic matter on a large scale by means of nascent oxygen liberated from water by the electric current, will probably never be more than a dream. Attractive as the process seems, the necessary conditions for accomplishing it could probably never be realized on a city's water supply or on its sewage. One word in this connection about the nascent state of an element, of which we hear so much nowadays. It is a well-known chemical fact that elements just liberated from combinations are much more active than in their ordinary condition. Nascent hydrogen, for instance, is a powerful reducing agent, nascent oxygen a powerful oxidizing agent—properties which are lost when these elements have assumed their molecular condition.

In some of the recent literature which I have read on the electrical purification of water, I have come across the idea that a nascent substance is one that is fresh in contradistinction to one that is stale; as if, for instance, oxygen liberated from water a minute ago would be more active than if it had been formed one hour. This is very wide of the mark; it is only at the very instant of formation that an element has enhanced powers due to its nascent or new-born condition.

The more recent systems of purification of water and sewage by electricity belong in the second class, that is, the decomposition, by electrolysis, of a solution of common salt. When a solution of salt (chloride of sodium) is decomposed by electricity, we have sodium liberated at one pole and chlorine at the other. The sodium is immediately oxidized and combines with the water present, and a solution of caustic soda results. By suitable mechanical contrivances the chlorine gas may be conducted away from the other pole as fast as liberated and collected as such. This method of making caustic soda, it may be said incidentally, is yet more or less in its experimental stage, but it seems not unlikely that the electrolytic production of caustic soda from common salt may become one of the world's great industries.

But if instead of separating the caustic soda and chlorine from each other in this process, they are allowed to recombine, we have a complicated series of reactions, resulting in the formation of various products dependent on the concentration of the liquid and its temperature. The principal product, under ordinary conditions, is sodium hypochlorite, variously named chlorinated soda, chloride of soda, and, in pharmacy, Labarraque's solution. A corresponding and entirely analogous compound is the so-called chloride of lime or bleaching powder, in which lime takes the place of soda.

This, then is the substance, sodium hypochlorite, with which we have to deal in the method of electrical purification which depends on the electrolysis of a solution of salt or sea water. When the current of electricity has, in the manner above described, formed a sufficiently concentrated solution of sodium hypochlorite, this solution is mixed with the sewage or water to be purified.

I would remark first, that there is nothing new in the application of electricity to produce the hypochlorites, except so far as the introduction of the modern dynamo enables us to generate electricity at a much less cost than formerly, and consequently to use it economically in industrial chemical operations. Second, there is nothing new in the use of sodium hypochlorite as a disinfectant, deodorizer, and germicide. In the very valuable report on disinfectants published by the American Public Health Association in 1888, the hypochlorites were shown, experimentally, to be among the most effective of all disinfectants in their action; 1% of a solution of sodium hypochlorite, containing 6% of available chlorine, destroyed the "bacillus anthracis" in two hours; 2% of this solution was effective in 30 minutes.

Of the corresponding lime salt, or bleaching powder, the committee reported that a solution of this substance, containing 25% of available chlor.ne was effective in a 1% solution in one or two minutes, and that a solution of one-fourth of this strength would kill "bacillus anthracis" and "bacillus subtilis" in two hours. The two hypochlorites of sodium and calcium were thus shown to be equally efficacious, the activity depending on the amount of hypochlorous acid present, or, in other words, of available chlorine.

The so-called electrical purification of water by treating it with an electrolyzed solution of salt is thus seen to be simply a process of disinfection by sodium hypochlorite; electricity, as such, has nothing to do with it. There is nothing peculiar in the sodium hypochlorite produced by electrolysis; it has no different properties from that made by the ordinary process of passing chlorine into a solution of caustic soda. That other compounds are formed in small amounts by the action of chlorine on caustic soda is true, but it has not been shown, nor is it probable, that any one of them has as potent germicidal and oxidizing power as the hypochlorite.

Ozone is generally supposed to cover a multitude of sins of pollution and quietly to destroy them, but we do not know much, if anything, about its germicidal power, and there is certainly no good reason for attributing any of the disinfecting action of an electrolyzed salt solution to ozone, even did we certainly know it to be present.

It is unfortunate, I think, that the advocates of this system of purification of water and sewage are not content to attribute the purifying action of the electrolyzed solution of salt solely to the hypochlorite formed. There is nothing gained scientifically by calling it "electrozone" or an "electro-saline solution," for there is nothing mysterious about its action, as these terms would lead one to suppose. Nor is it proper to speak of this system of purification in any sense as an electrical one. If one were to purchase two bottles of sodium hypochlorite of identically the same composition, one prepared by a chemical process, and the other by the electrolysis of a salt solution, he would not expect to find them called by different names. To call the latter an "electrical disinfectant" would be simply fantastic.

Finally, is it desirable in any case to treat a city's water supply with a powerful disinfectant like the hypochlorites? When the question is put in this bold form I cannot think it will receive the approval of engineers and sanitarians. Leaving out of consideration the difficulties and cost of disinfecting effectively and uniformly the water supply of a large city, the idea itself of chemical disinfection is repellant. Every city should jealously guard its water supply. It is a sin against decency and good morals to permit the pollution of drinking water by sewage and house drainage. It is a still greater wrong, not to say a foolish blunder, to permit the open pollution of its drinking water streams, and then systematically to disinfect them.

In cases where a water supply has got into such a hopelessly bad condition that nothing will render it safe but disinfection by chloride of soda or chloride of lime, it is high time, I think, to abandon the supply, and in this opinion I feel sure most water-works engineers will coincide.

*A paper read before the New England Water-Works Association, March 14, 1894. The paper will be printed in the Journal of the Association.

**For descriptions of processes for the electrical treatment of sewage and water, see the accounts of the Webster process in Engineering News of April 13 and Oct. 26, 1889; the Hardie process, Engineering News, Feb. 2, 1889; the process of the Electrical Water Purification Co., Engineering News, May 17, 1890. None of these processes ever passed the experimental stage, so far as we can ascertain. In Engineering News of July 13, 1893, the treatment of sewage at Brewster's, N. Y. by means of an electrolyzed solution of common salt was described in detail. In our issues of July 27, Aug. 3 and 10, 1893, there appeared brief notes relating to the application of the same system to a portion of the water supply of New York city, the plant also being located at Brewster's, N. Y. These last named plants were built by the Woolf Electric Disinfecting Co., of New York, for the New York Department of Public Works.

REMOVING THE CHANNEL PIER OF THE SCIOTO RIVER BRIDGE.*

By M. L. Byers.

Among the structures damaged by the floods in the spring of 1893 was the east pier of the single-track bridge of the Cincinnati & Muskingum Valley Ry., across the Scioto River, near Columbus, O. When the writer took charge, falsework had been driven to relieve the pier, plans prepared, bids requested, and the estimate of the probable cost was $3,500. The plan provided for a masonry pier rising on three lines of piles driven at about 4 ft., longitudinally, between centers, capped transversely with a grillage of two courses of 12 × 12-in. hard wood timber, drift bolted to the caps. From base of rail to low water-mark was 28 ft. 9 ins., and the top of the grillage was 10 ft. 3 ins. additional, or 13 ft. 3 ins. to the top of the piling.

As a protection against undermining, a ring of piling had been previously driven at about 25 ft. from the pier, entirely around it, and the space inside filled with riprap and blast furnace slag. The last flood had undermined the nose of the pier to some extent, and on the subsidence of the flood the pier cracked from top to bottom and began to settle badly, requiring temporary bents to be placed to carry the two spans resting on the pier. A single bid of $8,500 was received for the work. An investigation at this time showed that the two spans were carried by temporary bents on either side. The space between the pier and the old piling had been filled as described. At a depth of 18 ft. below low water a bed of hard blue clay was found, while in the vicinity of the pier, and carrying it, was a mound of about 80 ft. in diameter of sand and gravel, extending to the surface of the water, the clay being exposed beyond the base of the mound.

As the temporary bents were but about 13 ft. apart, the boat, 40 ft. long and 14 ft. wide, which had been built for use in driving the piling, could not pass between them, and it was evident that some sort of a cofferdam was a necessity. This, to inclose all the temporary bents, needed to be about 65 ft. square, and would require piles about 28 ft. long. It was also probable that a heavy expense for pumping would be incurred. Under the most favorable circumstances, about eight weeks would be required to build this dam, and the excavation would require about three weeks more. This would bring it to the last of October before the pier could be out of danger from high water, and low water could not be counted on after the middle of September. An estimate of the probable cost amounted to something over $8,000.

To do the work economically required that the cofferdam be dispensed with, by sawing the piling off to a level under water, or by possibly dispensing entirely with piles if the bottom be found suitable. The difficulty presented was to make the excavation, and the riprap could not be removed until the pier itself was removed. A dredge small enough to work between the bents was not to be had, and the job was not large enough to pay the expense of purchasing the special tools required. It was finally resolved to use a scraper, made at the railway shops, of old boiler iron strengthened by three ribs of light iron rail and operated by a 20-HP. two-drum hoisting engine mounted on an island formed just above the pier. The towing line was run direct from one drum to the back of the scraper, and the back line from the other drum ran over a sheave on the bridge to the front of the scraper, thus giving entire control to its movements. It was necessary to remove 13 of the old piles, forming the upper end of the ring. This was done by sawing off to a level the piles at either side, and using two 20-ton hydraulic jacks resting on these, with a 12 × 12-in. timber between, chained to the pile to be drawn.

The dredging was completed over the entire foundation to a depth of 12 ft. on Sept. 1. To prevent the scraper from upsetting when it came in contact with a piece of riprap, a piece of rail was bolted across the end, a few inches above the teeth. The time occupied was much increased by insufficient boiler power. The towing line used was a ¾-in. hemp center wire rope, and the back line a ½-in. rope of the same character. Somewhat larger ropes would have been better, as they were completely worn out when the work was finished.

After a depth of 12 ft. had been excavated throughout, it was decided to dispense with the piling, and a crib of six courses of 12 × 12-in. timber, arranged so as to form three lines of pockets, each 4 × 2 ft. 6 ins., open at top and bottom, was built in place. The middle pockets were provided with slat bottoms and filled with cobble stones. Two-inch tongued and grooved siding was nailed to the top course of the crib and braced so as to form a cofferdam, and the crib was sunk by placing rails on the top of the dam thus made. To level the bottom for the final resting place of the crib, a rail 11 ft. long was dragged back and forth over

*Abstract of a paper presented at the meeting of the American Society of Civil Engineers on March 21.

it. The reason for putting no bottoms in the outer pockets of the crib was that at some points the earth was soft underneath the crib and had been excavated deeper than at other points, and it was desirable that those should be filled up. After sinking, a slight ridge of gravel and sand was thrown up entirely around the crib, and then each outside pocket had placed in it about ½ cu. yd. of rich mortar and an equal amount of concrete, all of which was thoroughly rammed. This was done to force the mortar under the edges of the crib and into the gravel, where it had been loosened. The center pockets were then treated with a rich grout, and the outside pockets with cobble stones and grout. The 18 pockets contained 1,008 cu. ft. in all, and the writer estimates that there were 525 cu. ft. of voids in the pockets and 189 cu. ft. in the gravel underneath, which were filled by the grout.

Pumping was started too soon, and there was considerable leakage through the bottom and sides of the crib. This was overcome by piling sand and dirt around the crib until the water was cut off. The pumping plant consisted of three ordinary barge pumps.

The actual cost of the work was as follows:

Removing old pier	$189
Excavation, including cost of scraper and wire rope	341
Foundation, including cost of timber, framing, concreting, pumping and cement	750
Masonry, at $7.50 per cu. yd.	1,955
Total	$3,235

RUSTLESS COATINGS FOR IRON.

The following is a translation of Mr. Frederic W. North of a paper read before the Paris Societe d'Encouragement by M. Octave de Rochefort-Lucay, on the new Bertrand processes for coating with magnetic oxide and enameling iron and iron carburets, and on a new process of tinning for cast iron.

Messrs. Barff and Bower were the first to practically coat iron, steel and cast iron with magnetic oxide, so as to form, at the cost of the metal itself, the protective layer that is obtained usually from paint, or from enameling, etc., with a thin coating of a metal that is not oxidizable.

The Bertrand processes are more simple than those of Bower and Barff, and are based on a new discovery in chemistry, and may be stated thus: If a thin adherent film of another metal is formed on the wrought iron or on the cast iron, and this iron or cast iron, heated to 1,000°, is exposed to a current of oxidizing gas, the oxygen penetrates through the film, oxidizes the iron or the cast iron, and under these conditions, magnetic oxide is the result. The formation of magnetic oxide, thus obtained, continues indefinitely, and the thickness of the coating of oxide increases according to the period of exposure to the oxidizing current, providing the temperature remains at about 1,000°.

As to the film of metal deposited in the first instance, it disappears in some obscure way, forming oxides which mingle with the magnetic oxide or volatilize according to the nature of the metal of which they are composed. M. Bertrand had then to find the best metal and the best method for depositing it on the article to be coated, and he has found that bronze, a mixture of copper and tin, gives from a practical point of view every satisfaction. For depositing this bronze on the wrought iron and cast iron, M. Bertrand uses electricity or wet baths, and uses sulphophenolic acid.

The following is the method adopted in the Bertrand manufactory for an oxidation: The article is cleansed (the cleansing is not indispensable), then dipped a few moments in a bath containing a solution of sulphophenate of copper and tin. The coating of bronze being formed, the article is immediately washed with cold water and dried with sawdust. The article dried is put into a furnace. Oxide forms, and at the end of fifteen to thirty minutes (according to the articles) the articles are taken out, sufficiently oxidized. The coating produced varies from 1-10 to 1-5 of a millimeter.

M. Bertrand uses electricity to ascertain if the coating is of sufficient and uniform thickness, and in doing so he makes use of bells. If in putting the two wires in contact with the oxidized article the bells ring, the current passes—the oxidation is insufficient; if it remains silent, the oxide formed is of sufficient practical thickness because it prevents the electric current from passing.

Process for Tinning Cast Iron.—M. Bertrand has also used sulphophenolic acid to obtain tinning on iron. He dissolves salts of tin in a mixture of water and sulphophenolic acid at the rate of one per cent. of tin salt, and five per cent. of sulphonhenolic acid. In this mixture the article, which is previously cleaned, is dipped; and is at once covered with an adherent coating of tin, and afterward by the means of rotating brushes in wire and cloth, the coating of tin is polished, and a result obtained which is both effective and cheap.

Process for Enameling.—There are not more than two processes for enameling cast iron. In the first, called hot, the iron, heated to a vivid red, is powdered with a flux powder (borosilicate of lead), distributed with a sieve, then it is heated, and when the flux fuses it is powdered afresh with glass more soluble, forming the glaze of the enamel. This process, the only direct enameling, is dangerous to the operator, and even impossible for large articles, nor does it allow of decorations. The second process consists of dressing the cast iron either by three distinct and successive operations in the furnace with a kind of pottery. In the Bertrand enameling, the article is first coated with magnetic oxide, then dipped in borosilicates of lead, colored by metallic oxides, in which is added a little pipe clay in order to give rather more body. The article thus covered cold, by dipping or with brushes, is put into the furnace; the enamel adheres and vitrifies at the usual furnace temperatures used by enamelers. By putting a coating of colored enamel with a brush on a first coat simply plain, it is possible to make any decorations desired, which may be burnt in at one operation for outdoor vases, etc. These results, due to the first oxidation with magnetic oxide, are remarkable, as much for the color as for the tenacity of the enamel and its resistance to rough usage.—"Journal of the Society of Arts."

PERSONALS.

Mr. James Howard, engineer, fell overboard from a ship while crossing the Gulf of California and was drowned.

Mr. I. Burnett, for several years inspector for the Illinois Steel Co., has taken a position with the Q. & C. Co. as inspector and in charge of the application of Servis tieplates.

Mr. A. L. Reese, Chief Electrician of the Maryland Steel Co., was killed by an electric shock at Baltimore, Md., while arranging the wires for demonstrations at a lecture on electricity.

Mr. Freeman C. Coffin, civil and hydraulic engineer, has opened an office at 53 State St., Boston, Mass., and will make a specialty of water supply, water power and sewerage.

Mr. Samuel Van Syckle, who died at Little York, N. J., recently, was the originator of pipe lines in the oil region, the first being laid on account of the enormous charges made by the teamsters for transporting the oil in barrels.

Mr. M. A. Martin, Superintendent of Bridges and Buildings of the Missouri, Kansas & Texas Ry., has resigned, and the duties of the position will be performed by Mr. C. A. Wilson, Chief Engineer.

Mr. William Stevenson, formerly General Superintendent of the Northern Division of the Lehigh Valley R. R., died at Jacksonville, Fla., March 11. He was born in 1835 and studied engineering, being engaged on the State Line & Sullivan R. R. and other works. He was in charge of the construction of the Easton & Amboy Division of the Lehigh Valley R. R., and left in 1875 to become superintendent of the Geneva, Ithaca & Sayre R. R. In 1881 he became superintendent of the Pennsylvania & New York R. R., and four years later managing director of the Southern Central R. R. In 1889 he was appointed General Superintendent of the Northern Division of the Lehigh Valley R. R., which failing health compelled him to resign in October, 1892. He had charge of the construction of the extension of this division to Buffalo, and as soon as it was finished and in operation he asked to be relieved.

Mr. Allan Campbell, Hon. M. Am. Soc. C. E., formerly Commissioner of Public Works and also Comptroller of New York city, and one of the oldest American civil engineers, died at his residence in New York on March 18. Mr. Campbell was born in Albany, N. Y., in 1815 and at an early age he began the practice of civil engineering, having been, according to report, the chief engineer of a railway when he was but 21 years old. He was engaged for a time on the Erie Canal and on the Ohio River improvement. In 1849 he went to Chile and there built the first railway in South America between Valparaiso and Santiago, the late Mr. Walton White Evans having been associated with him in that work. Some years later he was Chief Engineer and then for six years President of the Harlem Ry. During the Civil War he was employed on the harbor defences of New York city. He was then Chief Engineer of Construction on the Union Pacific Ry.; chairman of the board of engineers, having in charge the construction of the improvement of Fourth Ave. with its depressed ways, and, on Jan. 21, 1876, he was appointed Commissioner of Public Works for New York, under Mayor Wickham, and on Dec. 10, 1880, he succeeded Mr. John Kelly as Comptroller of the city of New York. Mr. Campbell became a Member of the American Society of Civil Engineers on Feb. 19, 1868, and was made an Honorary Member of the Society March 1, 1892.

NEW PUBLICATIONS.

SEWAGE DISPOSAL IN THE UNITED STATES.—By Geo. W. Rafter, M. Am. Soc. C. E., and M. N. Baker, Ph. B., Associate Editor Engineering News. New York: D. Van Nostrand Co. London: Sampson Low, Marston & Co., Limited. 8vo; pp. XXVI., 598; seven folding plates; 116 illustrations in the text; 91 tables and full index; $6.

If any one had prophesied a dozen years ago that there would be enough sewage disposal in the United States in 1893 to warrant the writing of a 4-lb. treatise on it, he would have probably been set down as a visionary by the average practical sanitary engineer. The crowded condition of the European nations forced the problem upon foreign engineers a long time ago, but American towns and cities have gone on discharging sewage into watercourses year after year, and it became such "standard practice" that there was much hesitancy in breaking away from it even in cases where purification was dictated by all considerations of expediency and economy.

We are past that era now, as the book before us amply testifies; but it should be said here that while the term "sewage disposal" has become significant in the popular mind of chemical or land treatment or filtration, the authors construe the title of their work in its broadest sense and discuss at much length the problems which arise in the discharge of sewage into watercourses and bodies of water. At the same time the larger part of the book is devoted to the subject of purification, and every American sanitary engineer has reason to be grateful that a treatise on sewage purification is now available which discusses the subject from the standpoint of American requirements and American practice. Manifestly, however, in view of the many years which European engineers have been thrashing over this matter a great deal of valuable experience has been accumulated there, and the authors have not hesitated to draw from this experience, facts and data that are of practical value to American workers in this field.

The book is divided into two parts, the first treating at length the essential principles involved and the second describing works built and in operation. The two opening chapters are on the relation between the communicable and inter-communicable diseases of men and animals and public water supplies, statistics being freely used to show the intimate connection which exists between typhoid fever and sewage polluted water.

Stream pollution and self-purification and the rational view of the disposal of sewage into tide or other large bodies of water are next discussed. Under stream pollution the pioneer work of Massachusetts is outlined quite fully and the later work of Maine, Connecticut, New York, New Jersey, Pennsylvania, Illinois and Minnesota is referred to at such length as its importance demands. Closely related to these subjects are the legal aspects of the case, to which a separate chapter is given.

The quantity of sewage and the variation in its rates of flow is discussed at length, for which purpose the available statistics regarding water consumption (largely from the Manual of American Water-Works) and sewer gagings are brought together in compact form and are supplemented by statistics of growth of population. In this connection there is given for 195 cities, ranging and classed in order of size from New York to Jackson, Tenn., or from 1,500,000 to 10,000, their 1890 census population, total and per capita (inhabitant instead of actual consumer) daily consumption and population per tap, the latter being added as some index of the proportion of the population supplied. Upon analysis of these figures it is concluded that the use of water in different cities does not follow any special law, but figures are given which conclusively show that the use of meters is a very important factor in the reduction of water consumption, and therefore in the amount of sewage, notably from a separate system, all of which of course has an important bearing on the cost of outfall sewers and of the construction and maintenance of purification plants.

The discharge of sewage into tidal and other large bodies, aside from the reference to it already made, has a separate chapter, which gives opportunity to describe the condition of the Chicago River and its effect upon the Chicago water supply and to outline the report on the disposal of Chicago's sewage made by Mr. Chesbrough as early as 1855, which was one of the earliest studies of the kind made in this country and was largely founded on observations made during a visit to Europe. It is interesting to note that Mr. Chesbrough considered the advisability of pumping the sewage to reservoirs for subsequent use as a fertilizer, and more interesting still that nearly 40 years ago he anticipated the separate system of sewage by suggesting the future possibility of using the sewers for storm water and putting in small pipe for house sewage only.

with the idea of separating the latter for use on land. The Chicago system of disposal and dilution is described and illustrated in the second part of the book, and this chapter on disposal without purification outlines the sewerage system of the original Boston and the gradual pollution of the adjoining water, making necessary outfall sewers to the ocean.

A chapter on nitrification and the nitrifying organism, together with the chapters on intermittent filtration and the relation of the temperatures of air and soils to land disposal present some exceedingly pertinent information, much of which has either never before been considered in this connection or only in a fragmentary way. As to nitrification the early knowledge and investigations of the subject are reviewed briefly, after which the important papers by Robert Warington are considered and the work of the Massachusetts State Board of Health is reviewed in detail. This work is recognized the world over as of vast importance and is here taken up for the first time in a treatise on sewage purification. The chapter on temperatures is based on observations abroad and especially at the various agricultural experiment stations in this country, and is new in this connection. The Massachusetts State Board of Health has also done some important and much needed work to determine the relative efficiency and cost of the various chemical precipitants used in sewage purification, which are here first reviewed in detail in a book on sewage purification. Two other chapters, much of which are new in this connection, treat of the important adjuncts to sewage farms which silos, for the preservation of green fodder, may be made and of the effect of manufacturing wastes on fish.

From the preceding paragraph, especially, and from all that in turn preceded it, it may be seen that this work on sewage disposal contains much matter new to the subject and which is either not to be found elsewhere or, if so, only in a scattered way.

Reference should also be made to chapters in Part I. on the disposal of manufacturing wastes, sub-surface irrigation and beggiatoa alba, or sewage fungus, and its relation to sewage effluents.

In Part II. illustrated descriptions are given of some 40 sewage disposal plants, mostly purification works for municipalities or private institutions. Many of the city plants have been described in Engineering News, under the series of articles entitled "Sewage Purification in America," a part of which have been reprinted in book form. But the volume before us takes up some of the most important plants in much greater detail, presenting valuable quotations from engineers' reports which have become classic in engineering literature, but are now out of print. In addition the illustrated descriptions of purification plants for hospitals, asylums and schools are here brought together for the first time, even if previously available in any manner except by correspondence with the engineers or officials in charge.

These descriptions of existing works need no extended notice. They include all the general systems yet employed for sewage purification and take up the chemical precipitation works of Worcester, with its population of 90,000 or more, as well as the sewage farm of Redding, Cal., with a population of less than 1,000, as also some even smaller plants for private institutions. Eight appendices in a smaller type than the body of the book compress into small space the following legislation and one court decision regarding the pollution or sanitary protection of streams and lakes.:

(1) The English Rivers Pollution Act of 1876; (2) the New York State Act of 1885; (3) Rules and Regulations for the Sanitary Protection of the Waters of Hemlock Lake; (4) The Massachusetts Act for the Protection of Inland Waters as Amended in 1888; (5) Decision of the Chancellor, Newark, N. J., Aqueduct Board vs. City of Passaic (in regard to the pollution of the Passaic River by sewage.—Ed.); (6) The Virginia Act to Prevent the Pollution of Potable Water Used for the Supply of Cities, Passed in 1892; (7) Rules of the New York State Board of Health Governing the Preparation of Such Plans for Sewerage and Sewage Disposal Works as Are Required by Law to be Submitted to that Board for Approval; (8) The Minnesota Act to Prevent the Pollution of Rivers and Sources of Water Supply.

A full index closes the volume. The general makeup of the book is good, the type being large and clear and the illustrations above the average, the publishers having spared no expense in making the typography, illustrations, presswork, paper and binding both pleasing and serviceable. Generally speaking the authors treat the subject too fully rather than otherwise, except possibly in some of the details of operation and certainly in the matter of cost of construction and operation, on which points a book of this character can hardly give too much detail. But it is, of course, the fact that such figures are difficult to obtain, especially when the undertakings in question are most of them comparatively new and to some extent experimental.

In looking over the volume we are impressed with the contrast between such technical works as this and the best which were available a score of years ago. There was a time when "book knowledge" was depreciated more or less, even by educated engineers, and with much reason, in view of the highly theoretical nature of the best books available. But the best technical treatises of to-day are labor-saving tools of which the engineer of the last generation knew nothing. Were an engineer ignorant of sewage disposal desirous of studying the subject in the most thorough manner possible, to prepare himself for intelligently designing works, he would search all technical literature, American and foreign, in books, periodicals and proceedings of societies, for information bearing on the subject, and would then add to this an examination of all the principal works which time and means would permit him to visit. This is just the useful work which the authors of this book have accomplished and made its results available to the profession, and there can be no doubt that their work will be appreciated.

A STANDARD DICTIONARY OF THE ENGLISH LANGUAGE. Vol. I. New York: Funk & Wagnalls Co. 4to; morocco; pp. 1,060; $12.

We have before (June 1, 1893) noticed this important new dictionary in these columns. The first volume now issued quite meets the expectations which were raised by the prospectus. The dictionary promises to be noted for its unusual wealth of scientific terms. Among the prominent names in the list of editors we not those of Prof. Simon Newcomb, Prof. N. S. Shaler, Ralph W. Pope, Secy. Am. Inst. Elec. E.; Dr. T. M. Prudden, the bacteriologist; Prof. L. G. Carpenter, President Am. Soc. Irrigation Engineers; Hon. T. M. Cooley, Hon. Carroll D. Wright, and Dr. Geo. P. Merrill, author of "Stones for Building and Decoration."

THE BOOK OF THE FAIR.—By Hubert Howe Bancroft. Parts VIII. and IX. Chicago and San Francisco: The Bancroft Co. Folio; pp. 40, each part; $1 per part.

This is one of the serial subscription publications in which the sights of last summer's great Exposition are reproduced for the equal edification of those who saw the originals and those who had not that good fortune. One realizes how much the world owes to photography and the half-tone process of reproduction when turning over the pages of such publications as these. The two parts before us are devoted to the Woman's and the Children's Buildings and the machinery exhibits. The views in the latter are fairly well chosen but are hardly up to the average of those in other portions of the work, partly on account of the difficulty of getting good photographs of machinery and partly by reason of poor work at various stages of the process. The full page engraving of the Allis engine is especially execrable. A plate of views of peculiar interest is reproduced from photographs taken during the burning of the cold storage building, a spectacle which those who witnessed it will never forget.

REPORT OF THE TEXAS STATE RAILROAD COMMISSION FOR 1893.—Pub. Doc. 8vo; paper; pp. 249.

The principal point of interest in this report is the description of the work of the engineers employed to examine the property of all railways in the state for the purpose of estimating the original cost of the roads as required by the laws of the state. A personal examination is made of every mile of line and the excavations and embankments, bridges, culverts, stations and depot buildings, water supply, etc., are measured and noted. This work is now partly completed and the information obtained is being put in shape for the estimates of cost to be easily made.

TRADE PUBLICATIONS.

THE WIND ENGINE AS A PRIME MOVER.—The U. S. Wind Engine & Pump Co., Batavia, Ill. Paper; pp. 12; illustrations and tables.

The U. S. Wind Engine & Pump Co. has been instrumental in the establishment of many water-works plants in the smaller towns of the West, and devotes this catalogue to a description of windmills and other supplies used in that connection. Pumps, pipe, hose and hose carts are handled by the company. Some of the specialties are priced in the catalogue and a few useful tables are included.

WATER STATIONS.—U. S. Wind Engine & Pump Co., Batavia, Ill. 8vo; pp. 12; illustrated.

This is an illustrated catalogue and price list of equipment for railway water stations, including pumps, wind engine, tanks, the Mansfield water column and the Halladay tank fixtures.

LOCOMOTIVE.—Ball Compound Locomotive Co., New York. 8vo; pp. 20; illustrated.

This is a description of the design of the Ball four-cylinder compound engine, with drawings of engines for express and suburban service. On each side of the engine are two cylinders, the low-pressure in front with the high-pressure immediately behind it, and placed sufficiently to one side to allow the low-pressure piston rod to clear the high-pressure cylinder. The pistons move in opposite directions, and each has its own crosshead, main rod and coupling rod. No engine has yet been built. The consulting engineers of the company are Geo. B. Cornell and J. G. A. Meyer.

GLOBE SPECIAL CASTINGS AND WATER-WORKS FITTINGS.—Builders' Iron Foundry, Providence, R. I.; 16mo; illustrations and tables.

This handy little catalogue describes and gives revised prices of the well-known water-works specialties made by the above company, including the Venturi meter.

WOODEN STAVE PIPE; Allen's Patent. Built by the Excelsior Wooden Pipe Co., 204 Front St., San Francisco. C. A. Hooper & Co., Agents; D. C. Henny, Manager and Engineer; 16mo; pp. 80; tables and illustrations.

This trade catalogue is well worth securing for its interested illustrated description of wood stave pipe and its possibilities, and for its tables of flow of water through such pipe from 12 to 120 ins. in diameter, the intermediate sizes for each 2 ins. being given up to 48-in., then for each 6 ins. up to 96-in., then for 108 and 120-in. A few other useful tables are also given, and the half-tone views of pipe lines under construction or built are well executed and pleasing.

SOCIETY PROCEEDINGS.

CENTRAL RAILWAY CLUB.—At the next regular meeting, to be held March 28, the paper on "Air-Brakes, Their Inspection and Maintenance," read at the January meeting, will be discussed.

S. W. Spear, Secy.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The quarterly meeting of the association was held March 14 at Young's Hotel, Boston. A paper on the "Electrical Purification of Water and Sewage," was read by Prof. T. M. Drown, and is given elsewhere in this issue. Mr. L. M. Hastings, City Engineer of Cambridge, described some experiments in measuring the flow of water in a 36-in. pipe.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the meeting held on March 14, Mr. J. Sellers Bancroft read a paper describing the latest form of the Emery testing machine. The paper is reprinted in another column. Following the paper there was some general discussion on the subject of testing machines, and stereopticon views of a number of machines of historical importance were shown. The next meeting will be held on April 11, the subject to be announced later.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on March 7, Mr. M. L. Holman, Water Commissioner of St. Louis, addressed the Club upon the general features of "The New Water-Works." The first agitation for water-works in St. Louis began in 1829, and the first works were built in 1833-36, with pumping station at the foot of Ashley St., and a wooden reservoir 100 ft. square at Collins and Ashley Sts. The pipes were all of lead, put in by the city. The works were later moved to the foot of Bates St., with a reservoir at 22d and North Market Sts. Mr. Kirkwood, of Brooklyn, was appointed to make investigations for a new system, and as a result the present system at Bissell's Point was constructed, going into service in 1872. There are now 420 miles of pipe in the city, the amount having doubled in the last 15 years. The general features of the new works at the Chain of Rocks and at Baden were described. The question of the best handling of sediment in the Bissell's Point reservoirs was discussed. The reservoirs being now operated at more than double their rated capacity, it was found necessary to operate them by continuous flow, which rendered it impossible to secure any great amount of settlement.

Wm. H. Bryan, Secy.

ENGINEERS' CLUB OF CINCINNATI.—At the last regular meeting Mr. M. D. Burke read a paper on "A Ship Canal from Cincinnati to Toledo," in which he reviewed the question of the construction of a canal of sufficient dimensions for transporting boats and barges of large size for the carrying of freight to and from the Lakes and the Ohio River, thus uniting the extensive water systems of the St. Lawrence and the Mississippi. He reviewed the work that has been done in past years in making surveys and examinations to this end on the line of the present Miami & Erie Canal with a view to enlarging and adapting it to that purpose. The author described the geological structure of the country that the canal traverses and gave the elevations at various points on and adjacent to the line and an idea of the possible source and extent of the available water supply. He suggested that an exhaustive examination and survey might develop that the summit level could be both lowered and shortened, thus lessening the quantity of water required. If such a canal were constructed, the soft pine and hemlock lumber, grain, salt, copper, etc., would be shipped from the North in exchange for yellow pine and hard lumber, corn, cotton, tobacco, marble, iron, coal, early fruits, and vegetables from the South. With Cincinnati's central position as a distributing center, and its almost unlimited supply of fuel, of limestone for flux, of iron ores, with direct water transportation from the Superior mines, the Miami Valley would become the great manufacturing center of the iron and steel industry of the United States.

INTERNATIONAL CONGRESS OF INLAND NAVIGATION.—The sixth annual meeting of this association is to be held at The Hague, the Netherlands, July 22 to 25, 1894. Announcements and copies of the programme may be obtained by addressing Mr. L. E.

Adser, Secretary of the committee having preparations for the meeting in charge, The Hague, Netherlands. American engineers wishing to contribute papers can do so through Mr. Francis Collingwood, Secretary American Society of Civil Engineers, from whom also further particulars may be obtained. Among the topics to be considered are the following: Construction of canals to permit rapid transit. Influence of shape and size of cross-section on rate of speed and resistance to traction. Least permissible depth of water beneath bottoms of vessels. Minimum radius for curves of canals; best material for protecting canal embankments; terminal facilities for canals and railways; methods of preventing ice blockades on canals; methods of locomotion on canals and rivers; best speed for cargo ships; improvements of navigable streams for low-water stages.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the meeting on March 8 a paper by Mr. J. J. Ormsbee, Superintendent of the Sequatchie Valley Coal & Coke Co., on "Coal Handling Plant at Pikeville, Tenn.," was read by the secretary. Owing to increasing competition among coal mines and the consequent demand for a better product, the old forms of chutes are now being superseded by those in which the coal is thoroughly cleaned and tenderly handled. The mine cars are carried to and from the tipple by a self-acting creeper chain. The coal is dumped on a back tipple, eliminating the large amount of breakage of coal usual in the old-style tipple. Lump coal is made over shaking screens, with 1½-in. perforations, and an inclination of 1½ in 12. It is then lowered gently into cars by a specially designed chute, having had nowhere a direct drop of more than a few inches. Nut and slack are elevated together and separated on shaking screens with ½-in. perforations, inclined 3¼ in 12. Good results are obtained from corrugating these screens. The uniformly sized slack made by this plant greatly improves the physical properties of the coke. The use of perforated metal shaking screens, compared with that of bar screens increases both the quantity and the quality of salable coal. The plant at Pikeville, designed and built by the author, has a capacity of 1,000 tons per day, and cost $4,400. Its estimated running ex- the January meeting, will be discussed. A paper will be read by Mr. J. B. Morford, Superintendent of the Canada Southern Division of the Michigan Southern R. R. S. W. Spear, Secy.

NEW YORK RAILROAD CLUB.—At the meeting on March 15 the first paper read was one by Mr. Geo. W. West, Superintendent of Motive Power of the New York, Ontario & Western Ry., on "What is an Economical Load for the Locomotive from the Standpoint of the Motive Power and Transportation Department?" The following is an abstract:

The capacity of steam engines is rated by their horse power, but the locomotive has to meet varying conditions and cannot be kept to a fixed paying load like stationary engines. Locomotives are required to exert their greatest capacity in starting trains. On my road nearly all our station stops are on grades, and, as a rule, the load must be gaged by the number of cars the engine can start. The result of these conditions has led to over cylindering the engines so that to use anywhere near the cylinder capacity of the locomotive we find ourselves running out of steam, and the result has been that we are obliged to build engines with large diameter cylinders to start the trains and when once in motion use steam at short cut-offs. In my opinion all differences exist on this one point, where we shall work the reverse lever. We must have the large diameter cylinder to start, but can build no boiler for a standard gage locomotive that will supply these large cylinders, working nearly full stroke, as we used to work engines with smaller cylinders, and in order to maintain full boiler pressure steam is used at such short cut-off that it has got to be a byword on many roads that the little engine of 1860 to 1870 would pull more cars than the modern engine.

Have you ever thought that in the '70's a 16-in. cylinder was counted big, and how it taxed the designers of locomotives to get boilers large enough to furnish steam for them? Now 20-in. and 21-in. are common, and still boilers are built that supply them, but not worked as men used to work the engines with 16-in. cylinders, at nearly full stroke.

This, in my opinion, is the stumbling block that leads to a difference of opinion as to what is a load for a locomotive; for anything that is an overload cannot be economical, either as to the motive power and transportation departments or the maintenance of way department. As an illustration: In 1890 our company purchased ten heavy mogul engines with 19 × 24 cylinders; two of the ten were assigned to passenger service, three to milk train service, and the other five were put in the rounds with 15 new consolidation engines with cylinders 20 × 24 ins. When the moguls in freight service had made from 44,000 to 45,000 miles we were obliged to stop them for tire wear. The three on milk trains made 75,000 miles, with tires in better condition than any of the five on freight were when they had made but 50,000 miles. The two on passenger trains made 100,000 miles, and tires in better condition than any of the other eight of same class which were making 45,000 and 47,000 miles, respectively. Before the three in milk service needed shopping, we were pressed for power, and purchased two moguls with same size cylinders and drivers, but a little less weight, that were built for another road. Our plan was to put the newly purchased engines on the milk trains, and relieve our own moguls for freight service. The new engines would not haul the milk trains, which demonstrates to my mind that the milk train was the capacity of our moguls, the freight load too heavy, and the passenger load not enough. A locomotive weighing from 50 to 60 tons cannot wear a set of tires to an extent requiring turning, making only 45,000 miles without injury to the track, as well as machinery.

I cite these cases to prove that a locomotive, like a horse, has a capacity, and when it is exceeded it is unprofitable to a railway company. The easiest, and in my opinion the best, way to decide what is an economical load, is to have the heads of departments confer frequently and study the interests of the company more than those of their own special department.

The next paper was one by Mr. W. J. Wattson, Division Superintendent of the New York, West Shore & Buffalo R. R., on "From What Class of Employees Should the Locomotive Fireman be Selected?" The following is condensed from the paper:

In considering this subject we should practically have the engineman, rather than the fireman, in view, because probably 99% of the men who become locomotive enginemen in this country are now advanced from the ranks of the firemen, and probably 75% of the locomotive firemen ultimately become enginemen. The best practice is embodied in the following remarks: 1, The fireman should invariably be selected from employees engaged in road service; 2, the firemen should be selected from among the men filling the position of head brakeman on freight trains, who should have been especially selected with reference to their fitness for firemen; 3, in selecting firemen the man's promise of becoming a good runner should be the controlling consideration; 4, as a general rule, the fireman who has the least promise of becoming a satisfactory engineer is the one who is selected from the ranks of the engine wipers.

ENGINEERS' CLUB, OF PHILADELPHIA.—At the meeting on March 3 Prof. Edgar Marburg read a paper on "Current Practice in the Designing of Plate-Girders." He said that while theory had been a valuable guide in shaping existing methods of design, the matter lay to a certain extent beyond the possibility of a purely rational treatment. Very few tests of built beams have been made in this country. A valuable series was conducted in Holland in 1879, and a few others have been reported within recent years in Austria and Germany. These experiments were made chiefly, however, with a view to studying the comparative behavior of different materials under varying conditions of workmanship, and throw little light on questions of design. The influence on the strength of a plate-girder of such matters as thickness of web, size and spacing of stiffeners, character of splices, eccentricity of flange stress, etc., is scarcely better understood to-day than it was 15 or 20 years ago. Nearly all specifications require, first, that the web must be of sufficient thickness that the mean intensity of shear may not exceed a prescribed limit; second, that the bearing of flange rivets must not be greater than a specified unit value; and third, that the web thickness must not be less than a stated minimum. Various standard values for allowable intensity of web shear were then given, the writer stating that the usual figure of 4,000 lbs. might, in his judgment, be safely doubled for a properly stiffened web, provided that the rivet bearing is kept within proper limits by the use of 6 × 6 in. flange angles with two lines of rivets, staggered.

With regard to stiffeners, the greatest diversity of practice is again apparent. Rules based solely on the ratio of depth to thickness are arbitrary, since with a web of uniform depth and thickness there is unquestionably more need of stiffeners near the ends, where the shear is maximum, than near the middle, where the live load shear is only about one-quarter to one-third as great, and the dead load shear is zero.

Though it seems highly improbable that future experiments will show that Gordon's formula, applied to web stresses, cannot even be made to serve as a rational basis for a semi-empiric expression covering any wide range of values, there is, nevertheless, nothing better available at present, and a choice must be made of adhering to this formula, the results from which have thus far stood the test of service, or of depending wholly on individual judgment. The writer thinks that a limiting ratio of unsupported depth to thickness should always be specified, beyond which, even though the conditions of the formula are satisfied, stiffeners should be required, in orded to insure the true vertical alinement of the web. This limit should not exceed 150, or, perhaps it might better be restricted to 125. Regarding the proper size of stiffeners, there are, absolutely, no positive data available. Precedent, and that of a most varied kind, is our only guide.

In the design of the flanges, practice is much more harmonious. The writer believes that every specification should contain Mr. Cooper's excellent provision that at least half the flange-area shall be of angles, or else the largest sizes must be used. In regard to unit flange-stresses, 7,500 lbs. per sq. in. for live, and 15,000 lbs. for dead stress, is favored in proportioning the tensile flange; the compressive flange being made of the same gross section. Every specification should contain a clause to the effect that the compressive flange shall be stayed against lateral flexure at distances apart not exceeding 25 or 30 times its width. Within such limits, a constant unit-stress may be safely used, instead of applying the modification of Gordon's formula frequently specified: which the writer believes to be wholly unreliable. The thickness of flange metal should be strictly limited to four times the diameter of the rivets, for punched holes, and, in extreme cases of long shallow girders where this would not admit of flanges of the usual type, the holes should either be reamed or a different form of flange used. The writer does not understand how, in the case of deck-girders, the common practice of neglecting the component due to the vertical loading in determining the bearing of flange-rivets on web-plates can be justified. If the uncertain element of friction between flange angles deserves recognition, it should be accorded rather through an increase in the allowable bearing intensity. It would seem advisable to specify in general that the pitch in the loaded flanges should not exceed 4 ins. The writer favors the counting of one-eighth of the web-section in each flange, rather than one-sixth, in order to make due allowance for rivets through stiffeners. The resisting moment of the web at splices should be developed rather by longitudinal plates attached to web directly within the flange-angles than by outside cover-plates.

The relative merits of plate and short span lattice girders have been made the subject of frequent discussions, but statements as to the span-limits within which one type may be preferable, do not convey a sufficiently definite meaning, unless qualified as to the contemplated loading. Assuming as a mean value, that specified by the Pennsylvania Railroad, namely, two 100-ton engines followed by 4,000 lbs. per lin. ft., the writer holds that the use of lattice-girders should not be permitted for spans below about 80 ft. for single track, and 70 ft. for double track, supported by three girders. In case the matter of first cost is one of sufficient moment to apparently warrant the adoption of short-span lattice girders, it should be considered that a better structure may be produced at essentially the same cost, in a plate-girder design, by relaxing somewhat the usual requirements specified for the latter.

The paper was discussed by Messrs. Barnes, Christie, Richards and Birkinbine.

Mr. J. Chester Wilson described the old viaduct bridge over the Conemaugh of 80 ft. spans, built in 1851 and destroyed in the Johnstown flood of 1889. Mr. Geo. B. Roberts, President of the Pennsylvania R. R. Co., made some remarks on the viaduct.

L. F. Rondinella, Secy.

COMING TECHNICAL MEETINGS.

DENVER SOCIETY OF CIVIL ENGINEERS.
March 27. Secy., F. E. King, Jacobson Block.
CENTRAL RAILWAY CLUB.
March 28. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
April 2. Secy., C. L. Annan, City Engineer's Office.
WESTERN SOCIETY OF ENGINEERS.
April 4. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
April 4. Secy., F. Collingwood, 127 E. 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
April 4. Secy., Wm. H. Bryan, Turner Bldg.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
April 6. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
April 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
April 7. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
April 7. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.
WISCONSIN POLYTECHNIC SOCIETY.
April 9. Secy., M. F. Schinke, City Hall, Milwaukee.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
April 10. Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILWAY CLUB.
April 10. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
April 10. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
AMERICAN RAILWAY ASSOCIATION.
April 11. Secy., W. F. Allen, 24 Park Place, New York.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
April 11. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
April 11. Secy., F. M. Curtis, P. O. Box 1576, Boston.
AMERICAN SOC. OF MECHANICAL ENGINEERS.
April 11. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERING ASSOCIATION OF THE SOUTH.
April 12. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
April 12. Secy., G. W. Shaw, Norton Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 12. Secy., C. H. McLeod, Montreal P. Q.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
April 12. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
April 14. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
April 14. Secy., Waterman Stone, Baird Building.
ENGINEERS' CLUB OF MINNEAPOLIS.
April 16. Secy., E. Nexsen, 504 Kasota Block.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
April 17. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
April 17. Secy., Clement F. Street, Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
April 17. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
April 18. Secy., S. L. Tinkham, 36 Bromfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
April 18. Secy., J. A. Pilcher, Roanoke, Va.
NEW YORK RAILROAD CLUB.
April 19. Secy., John A. Hill, Temple Court.
ENGINEERS' CLUB OF CINCINNATI.
April 19. J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
April 19. Secy., Howard Berge, 100 Washington St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charpiot, Macon, Ga.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
April 20. 201 Washington Building.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

We give considerable space this week to a description of the Emery testing machine with its latest improvements, as now made by Wm. Sellers & Co. The extreme accuracy of the Emery machine is pretty well known to engineers, but the peculiarities of its design, which are clearly explained and illustrated elsewhere, are not as well understood as they should be, considering the triumph of ingenuity and successful design which the machine really is. At the recent meeting of the mechanical engineers, at which the subject of testing machines was discussed, it was stated by Mr. J. Sellers Bancroft that a weight of 200 grains laid on the platform of an Emery machine of 500,000 lbs. capacity was sufficient to move the indicator needle 0.02 in., and thus actually set in motion material weighing more than 25,000 lbs.

It is interesting to note in this connection that when the Emery machine was brought to the notice of English engineers some years ago by a paper describing it, read before the Institution of Mechanical Engineers by Mr. Henry R. Towne, the wiseheads "jumped on it" as soon as the discussion opened. One man thought "it had been designed to overcome difficulty which did not exist, namely, tangible friction on knife edges." Another "could not understand how the Emery machine could be so reliable as it was claimed to be," etc. Then uprose Prof. W. C. Unwin, whose abilities as a scientist and engineer are so well recognized on both sides of the water, and quietly remarked that after an investigation of various testing machines in the market he had reached the conclusion that the Emery machine was the most accurate of all.

An epidemic of typhoid at Buffalo, N. Y., is just subsiding, which seems to have been due to a temporary drawing of the public water supply from a polluted source, owing to low water in the river. On several days in February it became necessary to take water from an old inlet said to be in a current carrying the discharge from up-stream sewers. From March 6 to 11, inclusive, the total number of typhoid cases reported was 26. On March 12 the number of cases rose to 26; the next day they jumped to 100, then fell to 88, 79, 52 and 25 on Wednesday, Thursday, Friday and Saturday, respectively, of last week, making a total of 406 cases from March 6 to 17, inclusive, and 370 in the six days March 12 to 17, inclusive. The population of Buffalo by the last census was about 256,000, and is now estimated at 300,000. The number of deaths from typhoid fever during this period is not stated. The total number of deaths from typhoid fever in Buffalo in the past eight years, it is stated, has never been above 129 in any one year, the number in 1891, and was only 112 in 1893, which latter figure, on a basis of 300,000 population, would be at the rate of 3.76 per 10,000 inhabitants, a somewhat high rate, but not so high as that of a number of cities with water supplies of very doubtful character. Two lessons to be drawn from this epidemic seem to be: (1) Render unnecessary the drawing of emergency supplies (much more permanent ones) from polluted source; this, we understand, is now being done at Buffalo. (2) Cities of the size of Buffalo, at least, should have their water supplies under such close supervision by chemists and bacteriologists that official warning of danger should be given before the seeds for a fatal epidemic are sown.

In connection with the epidemic at Buffalo, the article by Prof. T. M. Drown on the "Electrical Purification of Water," printed elsewhere in this issue, is of much interest, especially as there seems to be some likelihood at Buffalo of the use of "electrozone," referred to in the article. Professor Drown sets forth very clearly the nature of the two principal types of electrical treatment, and indicates that it is scarcely to be hoped, for the present at least, that the direct action of electricity upon water or sewage will prove to be a practicable mode of purification. He also shows that the use of electricity in this connection for the decomposition of a solution of common salt is merely one method, and that not a new one, of preparing sodium hypochlorite for use, the hypochlorite being just as effectual if prepared in some other way, and having been reported on at least five years ago by a committee of the American Public Health Association, which made an exhaustive report on disinfectants, and gave results highly in favor of this particular one. While referring to the electrozone, or to electrically prepared sodium hypochlorite, it is worth mentioning that this same method has been tried experimentally in Europe by M. Hermite. It also appears that the Woolf process, put in operation for treating both sewage and water by the New York Department of Public Works at Brewster's N. Y., in the summer of 1893 (see footnote to Professor Drown's article), is likely to be applied to the sewage of Danbury, Conn., where the company proposes to license the town to use the process to the extent of treating the sewage of 12,000 people for the sum of $2,000 per year. This sum includes, as we understand it, only the right to use the process, which, on the above basis, will cost 16⅔ cts. per capita, a trifle more than the total cost of chemicals at Chautauqua, N. Y., during the season of 1893, after the experimental period. The detailed cost of operating the chemical precipation works at Chautauqua was given in our issue of Feb. 1, 1894, as were the chemical results obtained. It should be added that so far as we can learn the principal value of sodium hypochlorite is as a germicide, and that it is of little or no value as a precipitant of the organic matter in sewage. In sewage purification chemical results are as a rule much more important than bacteriological, and in general it may be said that no electrical or so-called electrical process has yet been sufficiently developed and tested in practice to warrant judgment to be passed upon its merits as compared with others.

Twenty-story office buildings in our large American cities are doubtless a commercial necessity, made so by the excessive price of the land upon which they stand; while the fact that these high buildings can be erected, thanks to the development of steel construction and rapid elevator service, assists materially in raising the value of lands in the narrow limits of the principal American cities designated as the "office building" district. The American Surety Co. has lately paid nearly $1,500,000 for a piece of land about 85 ft. square in the office building district of New York city, or at the rate of about $8,000,000 per acre. To obtain a return in rentals upon the investment in land alone, story after story must be added to increase the floor-space to an amount which can stand the interest charge for land occupied. But there is a sanitary question involved in the erection of these extremely high buildings that must some day be taken into consideration and may ultimately define the vertical limits of these structures. A few isolated high buildings, as nearly fireproof in construction as the expenditure of money can make them, have little bearing upon the question of public comfort and health. But if their erection is purely an outcome of real estate values and returns upon these values, it is evidently only a question of time when certain streets will be lined on both sides with these towering structures, shutting out air and sunlight from the streets below and making all the lower stories of these buildings less desirable for office use. If the land is to increase indefinitely in value, it stands to reason that the buildings must increase in height; and where, then, is the limit? In New York these buildings would be confined to a comparatively narrow belt, with wide rivers on both sides, and the problem of ventilation can be more easily solved, and electric light may be substituted for the sun. But there would be, nevertheless, an excessive crowding of human beings on a limited area and the ultimate effect must be the reverse of healthful. With the later downtown land values the rentals of at least six stories are required to pay the interest on the real estate alone, and additional floors must be depended upon to meet the return for the investment in structural material and the profit of the owner. Every sale at excessive figures adds to the taxable value of the adjoining and as yet "unimproved" property, and it is now a question how long the owner can meet the demands made upon him out of the possible rentals of a five or six-storied building. Even now, daylight is at a premium, and in many buildings the highest rents are paid for the offices nearest the roof.

While the tendency to concentrate certain interests within certain limits must be recognized, and it is a tendency hard to change, the excessive erection of high buildings for this purpose may ultimately defeat the very end in view. Tenants may sometime find the lower five or six stories so undesirable, from lack of abundant sunlight and air, that they will break in upon tradition and even upon personal convenience and seek new centers of commerce. Should this take place, the owners of this property will either have to take very much lower rent for their offices generally, or find themselves holding ten-storied buildings propped up 100 ft. in the air, with the lower supporting stories about as available as cellars for all rental purposes. With the decline in rental value must come a decline in real estate values; and as nearly all the many high buildings of lower New York have been erected within the last ten years, it is none too soon to look a little more carefully into the future of certain land values. There is apparently a limit to the game; and it will come sooner in smoky Chicago and other large Western cities now indulging in the high-building craze, than in the comparatively much purer atmosphere of New York.

THE OWNERSHIP OF SURVEYS.

The ownership of surveys, or rather the ownership of all notes and data necessary for a complete record of a survey, is a question frequently causing trouble and a difference of opinion between the engineer or surveyor and the employer. On another page of this issue this question is taken up and discussed upon its merits by Professor Raymond, and he clearly shows that the ownership lies with the employer, and that when the surveyor fulfills his contract, the possession of private notes is of little real value to them.

This contract, in honor at least, implies that the surveyor sells to his employer either the whole of the time consumed in making this survey, and consequently all the information of any character obtained in that time; or he sells for a certain fixed sum data for a survey of this same tract or line, complete in every detail and including every item of information necessary for a resurvey of the same tract, either by himself or by another surveyor, with no further material than that supplied in map and notes furnished to his employer. If he does not do this he deceives his employer by giving him less than he paid for; or at least believes he paid for. If he fills his contract as here

indicated, any personal notes and data retained by the surveyor are of little present or future use to him. This is not in accordance with too common practice, and many surveyors believe that it is "business" to keep in their own office the only record of bench marks, the manner of setting corner stakes, the record of these corners as located on the ground, "private marks," etc., in the belief that they thus hold personal information that will secure to them any future work in the same locality. This may be "business," but it is not strictly honest and is a practice to be condemned.

As Mr. Raymond says, the only remedy for this is the enactment of state laws strictly defining what should be included on every property map filed for record, and making it a misdemeanor to not adhere strictly to the legal definition. By the enactment of such laws untold litigation concerning boundary lines would be avoided, and it would effectually stop more or less deliberate rascality on the part of land speculators and promoters of every kind. Purposely distorted maps, showing wide streets where there are narrow ones, meadow lands in the heart of swamps, highway and railway facilities which exist only in the imagination of the owner, or in some unborn scheme, all now appear on many maps of record, and are all intended to deceive the innocent investor who has no opportunity to personally investigate his intended purchase or investment. In the absence of law, these things are always possible, to the confusion not only of the purchaser, but of the attorney, engineer, or surveyor, who has to deal with them afterward. Properly framed state laws, vigorously administered, will alone remedy this evil, and it is to the interest of every honest man to use all the influence he can wield to hasten the enactment of such laws.

The old-time practice, still very common, of having non-salaried city surveyors, depending only on fees for work performed, is also to be condemned; and the suggestion of Mr. Raymond is good, that where fees are allowed these should be turned into the city treasury and the surveyor and his assistants should be paid a regular and fixed salary. Under the old system, corners, bench marks and other information necessary for fixing lines are regarded practically as the private property of the district surveyor, and are only on record in his private notebooks. By virtue of this information he practically holds office regardless of personal fitness or public interest, and it is time this system was abolished everywhere. Property lines are altogether too important to be made the subject of professional rivalry for office or work; and as long as essential data for their accurate location on the ground lie only in the hidden archives of an individual, their absolute loss is always possible; and what is worse, the record may be at any time intentionally falsified to deceive an unwelcome successor. It should be made compulsory by law, to so complete the map filed for record that any competent surveyor could relocate all the lines and corners without a shadow of a doubt as to what the original survey meant.

As a case in point, though not exactly connected with the class here dealt with, the writer is reminded of a bit of experience of a one-time chief of the water department of one of our largest cities. This chief succeeded to an office practically devoid of all records of work performed, and he was forced to have complete resurveys made of the much-scattered property, buildings, reservoirs, etc., under his control. The engineer charged with surveying the reservoirs finished the work above ground with little difficulty; but there was a chain of reservoirs connected by a very complicated system of buried pipes and gates, and it was absolutely necessary for the completeness of his work that this connecting system should also be accurately mapped. But here he met an obstacle in the form of reservoir-keepers who had held their offices throughout all changing administrations simply because they, and they alone, knew where the pipes, gates and stops were located and how they were connected with the several systems. These keepers positively refused to give away this private information, and there was a halt in the survey. The chief, however, was equal to the emergency, and sending for the keeper of one of the smaller reservoirs, he personally requested that he point out to his engineer all this underground plant. The keeper again refused to comply, and somewhat to his surprise, he was discharged upon the spot. The next morning a gang of laborers appeared at the reservoir formerly in charge of this keeper and a trench was cut clear around it; every pipe was uncovered and followed to its connection or stop and a complete survey was then made and mapped. It is hardly necessary to state that there was a sudden change of heart among the other keepers and the engineer in charge of surveys had little further trouble in getting all the information he needed. This case is mentioned simply as showing the possible evil of permitting individuals to hold as private property information upon which the comfort, and possibly the safety, of a great community depended.

In this same connection with record-keeping and map-making, something can be said of interest to city engineers, and a common law defining the form their records should take would be most advantageous in many communities. In these communities the sin is usually one of omission, and is committed for no other reason than that the holder of the office does not stop to consider what future trouble may arise, for him or his successor, from the neglect to properly and officially preserve some seemingly trifling detail of construction in his department. The exact depth of a foundation, the material under this foundation, a dimension hidden by filling, or by later work, may be each one of them of untold value in planning, estimating upon, or carrying out repairs or extensions of old work, or in making additions. To record this information at the time of actual construction is simply an office detail, involving a slight additional expense for a complete set of drawings showing the finished work and carrying upon its face, or with it, remarks, dates, statement of cost, etc. But to regain this lost data, after the structure has been in actual use for some time, usually involves trouble and expenditure out of all proportion to the possible original outlay.

It might here be mentioned, in connection with the chief of the water department before referred to, that his plan of preserving the resurveys so painfully and expensively obtained, was a most excellent one; at least, as far as the preservation of general but important data was concerned. In his case, every piece of property, with all its boundaries, monuments, dimensions and area; every engine-house, in elevation and plan and location of engines; every reservoir, with its system of connections, its capacity, etc., and, in fact, every item of important department property that could be so treated was drawn boldly to scale and then photographed down so as to be issued with the regular annual reports of the department. With these plans went printed matter, commencing with as detailed a history of the department, from its inception, as could be obtained, and descriptions of the reservoirs, pumps, etc. By distributing this data in the annual reports it was made a matter of public record in the truest sense; and his successors have reason to thank him for much that they could only have obtained by repeating his expenditure of energy and money.

But the real records of public work should be preserved in the offices of the city engineers themselves; they should be public property, carefully and systematically made and filed; containing all useful information and guarded against loss. Some engineers will tell us that their masters will not provide for the time and money necessary to keep these records in order, or to properly prepare them in the first place. This claim is, unfortunately, too true in many cases; but it is, nevertheless, the duty of the engineer to do all that he can in this direction, and systematic, well-studied methods of work will do many things that seem almost impossible until tested by trial.

Meanwhile, to return to the subject of map-making for record, the scheme sketched out by Professor Raymond, and given in the abstract of his article, should be carefully studied by all engineers and surveyors; and not only studied, but followed. The observance of the rules laid down will make the surveyor himself more careful in his work, and require him to gather the information necessary for a really complete map. He will certainly not suffer in reputation with his employer by giving him the full worth of his investment in money, and the amount of his business should be correspondingly increased. The surveyor is himself the best fitted of all men to appreciate the full value of complete and accurate data, and he feels the absence of it when dealing with the work of ignorant or careless fellow-surveyors. The first steps toward reform by legal enactment must come from them; and there is no better way of hastening this reform than by practically showing the advantages of better methods, and thus making more prominent the evils of the old.

The Bell Telephone Co. has petitioned the state of Massachusetts for permission to increase its capital stock from $20,000,000 to $50,000,000. In the course of his opening argument, the counsel for the telephone company gave some information as to the magnitude of the investment and business of the company. According to this argument the company has invested, since Jan. 1, 1885, the following amounts in round figures: Real estate, $6,000,000; underground subways, conduits and their cables, $14,500,000; overhead equipment and exchange, $12,500,000; long distance and toll lines, $10,000,000; aggregate spent before 1885, $31,000,000; total, $74,000,000. This outlay represents 488,521 miles of wire, on Jan. 1, 1894; and of this 115,000 miles are underground. Of telephones, 566,491 are now in use; there are 237,000 subscribers, and in 1893 there were 600,000,000 "talks" with these instruments: nearly 2,000,000 per day. As showing the growth of the business, the status in 1881 was about as follows: Telephones, 5,000; subscribers, 47,880; miles of wire, 29,714; talks (in 1884), 215,000,000. Over 10,000 persons are now employed by the company.

The drainage of the Kankakee swamp, a project described at length in our issue of Nov. 3, 1892, is being considered by the owners of lands in the district affected, which includes nearly all of Lake, Porter, Newton and Jasper counties, in Indiana. A drainage district is being organized covering nearly the whole of this territory and the amount of work involved in the first portion of the proposed improvement will aggregate some $400,000.

LETTERS TO THE EDITOR.

MINIMUM GRADE FOR SEWERS.

Sir: Noting the inquiry of "G. A. C." in Engineering News of March 1, I will say that in this city we find grades of 0.2 ft. in 100 ft. to give quite satisfactory results. We have grades that are still flatter, but they are not to be recommended.

In some instances, on very flat grades, we give the gutters greater fall than the streets; and on streets having curb grade level, we make the summit of the gutter midway between storm water inlets (we don't use stench trays, otherwise called catch basins) which we place from 200 to 300 ft. apart.

Wm. M. Whitten,
City Civil Engineer.

South Bend, Ind., March 3, 1894.

Sir: In "Notes and Queries" of March 1, G. A. C. inquires concerning flat grades and how to manage them. There are many portions of our city that are very flat, and the curb grades on portions of many of our streets are actually level. My experience is that on brick-paved streets, carefully laid, a fall in the gutters of 4 ins. per 100 ft. gives perfect satisfaction. On streets which are level or nearly so, it becomes necessary to introduce little summits into the gutters and to put catch basins about 400 ft. apart. In our city the street intersections are usually 416½ ft. apart. At catch basins the top of the curb is about 10 ins. above the gutter and the height of the curb above the the gutter at the summits depends on the distance run and the location of the summit. I believe in avoiding light gradients as much as possible; but when they cannot be avoided, this method gives good satisfaction, and is not unsightly as at first might be thought. Very respectfully, Jarvis S. Humphrey,
City Civil Engineer.

Findlay, O., March 13, 1894.

ADJUSTING TRANSITS.

Sir: Ohio has a law authorizing the county commissioners to establish a meridian in each county, adjust surveyors' instruments and keep a record of the declination of the magnetic needle.

I know of several instruments, which have been tried on the meridian established in this county and the difference between the maximum and minimum declination found at the same time by different instruments has been as great as 30'. I have had no opportunity to examine these instruments, but I think it safe to say that a part of this is due to lack of adjustment between the plane of collimation and the line of zeros.

In making this adjustment, I have used the follow-

ing method, which requires the use of an additional transit and observer: Set up the auxiliary transit about 20 ft. from the instrument to be adjusted and on somewhat higher ground. Bring both zeros of the compass arc and the vertical hair in the auxiliary transit in coincidence by moving both instruments in azimuth. Then set each objective at its stellar focus and direct the telescopes toward each other. If the instrument is in adjustment, the vertical hairs will coincide.

Few surveyors in "these parts" ever pay any attention to this adjustment, and as I cannot see that these records of declinations can be of any value without this adjustment, I have suggested this method.

I have also used another method which is as accurate as the above, when the line of collimation is vertically over the center of the compass arc and does not require the use of an additional transit. It consists simply of adjusting a reading glass to the objective, so as to render the zeros visible in the field of the telescope and making the hair cut the zeros as the telescope revolves. L. C. James.

Zaleski, O., March 2, 1894.

THE EXPANSION OF ICE IN STAND-PIPES.

Sir: In the comments on the failure of the East Providence stand-pipe, which have appeared in your columns, I do not find reference to the difference of expansion between ice and steel, nor do I find such data elsewhere, though it may be well known. In the St. Lawrence River, where the breadth is 1¼ miles, ice freezes to perhaps 18 ins. in thickness at the shores and half that thickness in the channel, before the usual January thaw; this is sometimes so long continued that the ice probably rises to a mean temperature of 20° F. or over, and is followed by perhaps the severest cold of the winter. Under such circumstances the ice cracks in the channel, being thinnest there, and I have seen these cracks as much as 4 ft. wide; these being attended with a temperature of — 20° or lower; it is possible that the change in the temperature of the ice may have been some 30°.

This would indicate a coefficient of expansion about three times that of steel, and a smaller difference than this would result in more stand-pipe failures than we hear of, if some other cause did not release the cumulative strains which such a shell of ice as has been described would naturally produce.

It is not probable that any strain is produced on the shell of the stand-pipe by freezing, for during this the cold is increasing in the ice film next the shell, and as the thickness increases this ice ring must crack or become porous; in either case it cannot be expected but that water will sooner or later fill these cracks, to be quickly frozen, and at the next increase of temperature produce strains on the shell.

The eccentricity of the ice ring, which has been referred to, is the probable "factor of safety." If the thinner part of the ring is weak enough to crush under the expansion due to a rising temperature the shell of the stand-pipe may stand the strain. If not, it may go to pieces, and the uncertain condition of the ice ring, the strength with which it adheres to the shell and other factors of uncertainty, will make even subsequent investigations of failure to some extent uncertain.

The result of these failures, however, show the need of protecting such structures from this uncertain element of destruction, and it is likely that some time or other the necessity of housing them, or providing for the weakening of the ice ring by means of waste heat from the engine or otherwise, will be more generally understood and acted on. G. W. Pearsons.

Kansas City, Kan., March 12, 1894.

(Ganot's "Physics" gives the coefficient of expansion of ice as 0.000,052, and of steel as 0.000,010,-788. The subject of ice expansion was discussed at length in our issue of Jan. 12, 1893.—Ed.)

CORROSION OF WATER PIPES BY ELECTRICITY.

Sir: By this mail I send you a sample of earth that may prove of interest, in view of the ever-increasing importance of the question of the electrolysis of lead and iron pipes by the return currents from trolley lines. The sample referred to was taken from near a lead service pipe, buried over 5 ft. in the ground, under the tracks of one of the electric railway companies in this city. The pipe was pitted deeply over its entire length, the injurious action being noticeably greater near the tracks, and diminishing towards the curb-line. At a point nearly under the tracks the pipe burst, being here eaten almost through. I regret being unable to send you a piece of the pipe; but we are saving it, along with many other lead and iron service-pipes which have been similarly destroyed, for future use.

You will note that the sample of earth sent you shows on one side a lead-coated impression made by the pipe as it lay in the earth; while all through the sample may be seen the lead, deposited in fine powder or crystals, very like silver-lead ore. Should the lump of earth be pulverized in transit, you will, if you will wash a little of the earth just as a California miner washes a pan of gold-bearing gravel, obtain a residue of a good many "colors" of lead.

It seems to me that the sample of earth shows very clearly just how the electrolytic action takes place.

Yours truly, Dabney H. Maury, Jr.,
Superintendent Peoria Water Co.

Peoria, Ill., March 15, 1894.

(The earth has been received and fully corroborates what Mr. Maury says above.—Ed.)

RAILS BENT BY LOCOMOTIVE HAMMER BLOW.

Sir: After reading R. E. K.'s letter in your issue of Feb. 15, I think that I may be able to help solve the question which he asks. In 1888, while I was in the Maintenance of Way Department of the Union Pacific Ry., on the Idaho Division, I was one day asked a similar question by the roadmaster. After he had stated where and in what manner the rails were bent, I told him that it was caused by the counterbalances of an engine which had been hauled over the road dead with its side rods down.

Upon examination I found that at two places some distance from Shoshone, several miles of track had been spoiled. Both places were on a down grade of about 1% going west. The rails were 52-lb. steel and the first bends were found to be on both sides the track and a distance apart equal to the circumference of the driver. The bend on one rail was one-fourth this circumference behind that on the other rail. After greater speed had been attained, farther down the grade, I found a lighter bend ahead and one behind the first bend referred to, which was now deeper and more noticeable than farther up the hill. This was caused by the front and rear drivers, and the bends were at unequal distances from the center heavy bend.

The engine which did the damage was a ten-wheel locomotive, built at a New England shop, which had been hauled dead all the way with all rods down. The front and rear drivers had slipped or gained on each other, so that the counterweights did not all strike at once on one side. The bends were from ¼ to 1½ ins. deep vertically and as much as an inch deep laterally at the worst places. The lateral bends were nearly always inward toward the center of the track.

Upon wiring my report to the superintendent, I was informed that a second engine being hauled dead in the same manner had broken a rail and ditched a train following or the rear end of its own train, at a point several miles east of McCammon Junction. I went there and found some two miles or more of track in a similar condition. I saw one rail taken out of the track which had such a sharp bend near the center that when one end was laid on the ties the other would stick up about a foot.

All trains were run at about four miles per hour over these places until steel enough to relay them could be brought on the ground. The rails at once began to break very fast, some breaking in two places under one train. Before it was relaid with new steel some 50 or more rails were broken.

The locomotives which did this damage were all of the same class, being a lot which were shipped to the Oregon Railway Navigation Co. The cause of the heavy and light bends noted above was the difference in the counterweights used on the middle driver to balance the main rod and on the front and rear drivers to balance the crank-pin and the two side rods.

The track was on a grade with both cuts and fills. The roadbed was of desert soil and native pine ties were used spaced 16 and 17 to a 30-ft. rail. All of the steel was 52 lbs. weight and of the standard section then used on the Union Pacific system. It had been in track about six years. The conductor had orders not to exceed 15 miles per hour; but at the place last mentioned the train ran so fast that it appeared that the engine being hauled dead must have got to jumping, as one rail would be found but slightly damaged while the one next to it would have excessive bends.

The lateral bends inward may be due to three separate causes acting singly or in combination: (1) A rail has little stiffness laterally compared with its vertical strength, and as it received the force of the blow and was bent down it would have a strong tendency to buckle sideways. (2) One set of counterbalances coming down on one side a quarter revolution behind the other side would give a rocking or rolling motion to the engine; this would cause the blow to be delivered downward and inward at the same time. (3) One wheel being on the rail and the counterbalance on the opposite wheel coming down with force enough to bend the rail downward, say, 1 in., the side thrust inward would be the difference between the base and the hypothenuse of a triangle whose base equaled the gage of the track and whose height was 1 in.. This effect would be small, it is true; but it might be enough to cause the rail to buckle under the vertical blow.

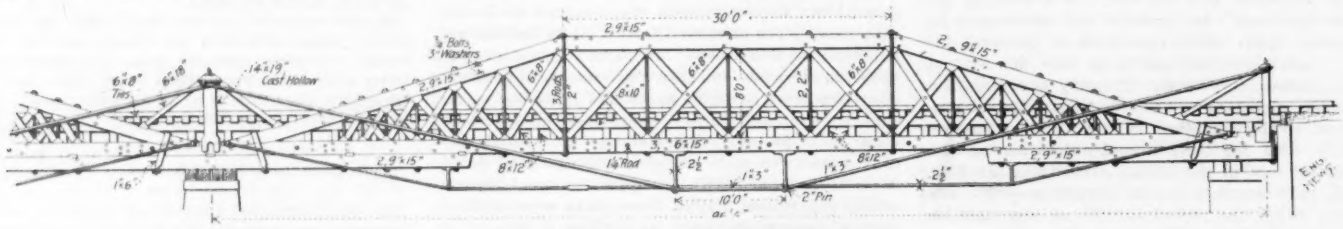
From the distances given in R. E. K.'s letter, I think that the bent rails were caused by a locomotive or locomotives having drivers of 62 ins. diameter. It may have had a side or main rod down, or have had an excessive counterbalance weight. The worn tire mark could have been caused by some of the following wheels, owing to difference of gage at the bend in the rails.

The facts in this letter are stated from memory and I believe that the maximum depression and inward bend were nearly twice as large as the distance stated above. I remember certainly that they were very numerous and that many rails were broken by succeeding trains under a speed of less than four miles per hour. Respectfully, Grant H. Nickerson,
M. Am. Soc. Irrigation Engineers.

Salt Lake City, Utah, March 11, 1894.

A HYBRID TYPE OF RAILWAY BRIDGE.

A correspondent sends us a drawing of a peculiar wood and iron combination truss bridge which did good service for many years on the Western & Atlantic R. R. (Georgia), and was torn down a couple of years ago to make way for a modern iron structure. We reproduce the drawing herewith as an excellent example of the nondescript structures, now rapidly disappearing, which flourished in the early days of American bridge building, and most of which can at least claim merit on the authority of the old saw: "Never find fault with the bridge that carries you safely over." This particular bridge was built in 1876 and was in constant use until 1891, when it was replaced by an iron bridge of the Warren truss type. It was the joint design of Capt. John Postell, at that time chief engineer of the Western & Atlantic R. R., and his carpenter, Mr. John F. Gramling. Mr. Postell seems to have been responsible for the general design while the details were worked out by Mr. Gramling. The design, or rather combination of designs, needs no comment except, perhaps, to say that we are informed that the structure proved very rigid under much heavier loads than it was originally designed to bear and gave very satisfactory service for nearly 15 years, a record which some more scientifically designed and more costly iron structures erected at that time and since have not equaled.



A COMBINATION TRUSS BRIDGE.

A NOVEL IRON RESERVOIR IN BORDEAUX.

The city of Bordeaux, says "Le Genie Civil," is erecting a metallic reservoir of somewhat novel form. The soil upon which it is to rest is essentially compressible and permeable; for 6 m. in depth it is peat and black mud and then comes a bed of poor sand, from 12 to 15 m. thick, resting upon rock. Under these conditions it is evident that for an ordinary reservoir foundations could only be secured by piles capped by a massive bed of beton.

On the other hand, to properly supply the part of the city for which it is intended the reservoir should have a capacity of 2,500 cu. m. and owing to the low level of the gravity source of supply, the sides of the basin could not exceed 2 m. in height. These conditions required a surface of 1,250 sq. m. and as a consequence the considerable number of piles thus demanded made the expense excessive for a reservoir constructed in masonry and the same objection held against a metallic reservoir resting directly upon the soil.

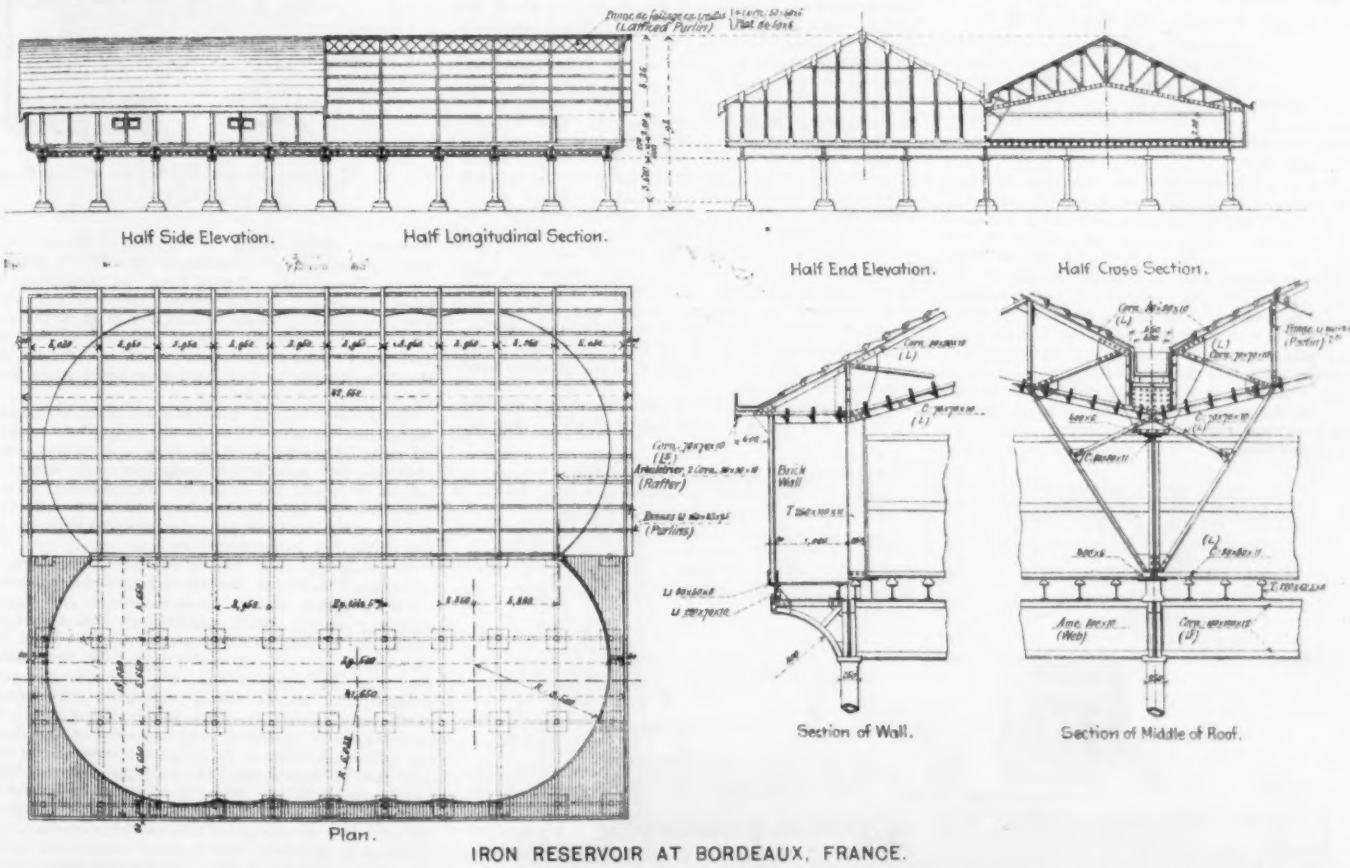
It was then determined to build an iron reservoir resting upon cast iron columns, which also carry the masonry walls. This reservoir will consist essentially of two compartments joined together, 17 m. wide, 39½ m. long and 2 m. high, terminating at the ends of the longer lengths of the basins in semi-circles of 9½ m. radius. By this disposition it is possible to clean and repair each compartment independently, the pipe system for supply and service being complete for each basin.

The longitudinal, exterior sides of the basin are made of curved plates, 3.95 m. long on the chord and with a radius of 6.95 m. As these plates work in tension the thickness has been reduced to 4 mm. The partition plates between the two basins are 8 mm. thick well braced by T-irons to resist the water pressure when one basin is empty. The bottom of the reservoir is flat and made of plates 5 mm. thick. This bottom is supported by shallow iron beams spaced 1.64 ft. apart, resting upon 11 girders (2.62 ft. deep) spaced 3.95 m. (12.95 ft.) apart and supported in turn by 77 cast iron columns. These columns are spaced 3.95 m. (12.95 ft.) apart, longitudinally, and 5.65 m. (18.53 ft.) transversely and they are 3.85 m. (12.62 ft.) high and 0.25 m. (10 ins.) in diameter. Each column stands upon a cut stone bed, 1 m. square, resting upon a mass of beton, 1.7 m. square and 1.15 m. thick, covering the heads of five piles, each from 10 to 13 m. long.

The shoes of the columns are 0.72 m. square, so as to assure the stability of the empty reservoir against a horizontal wind pressure of 35 lbs. per sq. ft. To assure the perfect seating of the shoes upon the base, these shoes were first set upon and adjusted by four oak wedges and the space beneath was finally filled with cement.

The entire reservoir is covered with a roof, for each division, of 17 m. span, the roof trusses being on a line with the supporting columns of cast iron. The masonry inclosing the sides of the reservoir is brick of different colors arranged in a decorative form on the exterior. The roof is lighted by 24 windows and it is covered by Marseilles tiles on wooden rafters.

The maximum load upon the columns of the center row is 60 tons when the reservoir is full, the roof loaded with snow and a strong wind blowing. The maximum load per pile is thus 12 tons. The total weight of the metallic part is 400 tons, of which 80 tons is in the cast iron columns and shoes. The total cost of the entire structure, including the foundations and masonry, was 195,000 francs, or $39,000. The reservoir was built under the direction of M. Gerard, Engineer in Chief of the city of Bordeaux, by Messrs. Chanlou, contractors, of the same city.



IRON RESERVOIR AT BORDEAUX, FRANCE.

COST OF CAR LIGHTING BY GAS AND BY OIL.

The following comparative estimates of the cost of lighting the cars on the Brooklyn Bridge Ry. with Pintsch gas and with oil lamps were submitted to the trustees at a recent meeting by C. C. Martin, M. Am. Soc. C. E., Chief Engineer:

Cost of equipment for 60 cars for gas:	
Cost of equipment for gas per car	$153.13
Cost of lamps per car	102.60
Cost of hangers per car	3.00
Cost of applying equipments per car	13.50
	$272.23
For 60 cars	60
Total	$16,333.80
Cost of oil lamps per car	54.00
Cost for 60 cars	3,240.00
Difference in first cost	$13,093.80

Cost of maintenance for one year, 20 cars 12 hours per night:

Cost of gas at $5 per M. or 7 cts. per car per hour	$6,132.00
Labor two men at $2 per day	1,547.00
Interest on equipment at 5% on $16,333.80	816.69
Depreciation on equipment at 10%	1,633.38
Cost of maintenance, gas	$10,129.07
Cost of oil, 2 cts. per car per hour	
oil at 6½ cts. per gallon)	$1,752.00
Labor, five men at $2, 12½ hours per day	3,869.00
Interest on equipment at 5% on $3,240	162.00
Depreciation on equipment at 10%	324.00
	$6,107.00
Saving in favor of oil per year	$4,022.67

It should be noted that the above estimate is applicable only to the special case for which it was made and does not apply to general railway service. Where a gas plant is built and operated to furnish the small amount of gas required by only 20 cars, the estimate of $5 per M. cu. ft. is probably a fair one; as the cost must inevitably be far in excess of that where the gas is made on a large scale. The figures for maintenance per car for both gas and oil are also excessive on account of the use of the lights during 12 hours per day. On ordinary railways the average daily use of lights in the cars probably does not average more than three hours. The allowance of 10% for depreciation of gas equipment is also excessive, according to our best sources of information.

AN INSTRUCTIVE EYEBAR TEST.*

This test was on a bar selected from nine bars 6 ins. × 1 9-16 ins. in size, on account of it showing seams in the head sufficient to cause its rejection. The test showed an elastic limit of 35,400 lbs. per sq. in., and the bar broke in the head at 41,500 lbs., with no elongation in the body of the bar. The fracture was square and granular and started in one of the seams. The head was cut off and the bar reheaded, and the new head showed seams also. One of these was chipped out and found to be ⅛ in. deep. At a stress of 60,200 lbs. per sq. in. a piece broke out of the new head with a square and granular section and no visible flaws. The body of the bar showed an elongation of 7%. The specimen test from this bar had given an elastic limit of 36,600 lbs.; strength, 63,100 lbs.; elongation in 8 ins., 30%; reduction of area, 49%.

*Abstract of a paper presented at the meeting of the American Society of Civil Engineers on March 21.

and indicated material of excellent quality. The question is, what was wrong with the manufacture to cause the test of the full-sized bar to be so unsatisfactory?

Analysis was made of drillings taken from the face of the second fracture and showed as follows: Carbon, 0.21%; phosphorus, 0.118%; manganese, 0.60%; sulphur, 0.126%. The phosphorus is high, but probably not higher than in at least 30% of material which is used at the present time. The primary cause of failure was in the sulphur, which is twice as great as the limit set as proper for material which is not to be reheated, and over three times as great as that set for material to be forged. The sulphur at the end of this bar was probably just at the critical point beyond which the steel would have crumbled in rolling, and more sulphur may have been absorbed in the heating. The bar was probably from the extreme top of an ingot, and its behavior is a strong plea for the cropping of ingots, so as to remove that portion into which the detrimental elements have segregated in cooling. The cropping of ingots has always been advocated for the removal of piping and unsoundness, and the segregation which occurs in all ingots seems to make its need imperative.

THE EMERY TESTING MACHINE.*

By J. Sellers Bancroft, M. Am. Soc. M. E.,

The essential peculiarity of the Emery testing machine is the method by which the stress produced upon the piece tested is conveyed to the scale and accurately weighed by mechanism which is entirely frictionless, and which hence responds to the same increment of load regardless of the amount of strain upon the specimen.

This result is accomplished by receiving the load upon an hydraulic support or upon a group of them, as the case may be. The general scheme is indicated in Fig. 1, which merely shows the relation of the parts, no attention being paid to proportion. The depth of the cylinder a is exceedingly small; the end is closed to prevent the escape of the contained fluid by a thin sheet of metal, b, upon which rests a piston, c, considerably smaller than the internal diameter of the cylinder. This piston is secured to the cylinder by a thin flexible fixing plate, or plates d, d, which permit a very small movement in the direction of the axis of the cylinder while rigidly securing it against any lateral movement. This longitudinal movement of the piston from no load to full load is not more than, say, 0.003 in., and as there is no hydraulic packing and no sliding, there is no friction beyond that of the fluid. This hydraulic chamber is connected by a pipe e, with a smaller but similar chamber, B, placed in the scale, which may be at any reasonable distance. The piston, C', of this latter chamber acts through the block, H, against the first lever, C, of the scale, which thus receives a fraction of the load upon the piston, c, determined by the relation between the areas of the two hydraulic cylinders, a and B.

The scale body is a rigid cast iron frame, indicated by the shade lines under the lever supports, G, G', G'', and over the reducing chamber, B. All the supports and connections of these levers are thin flexible plates of steel firmly secured or clamped to the levers and their supports and having a sufficient exposure between their fixed ends so proportioned to their thickness and the loads they have to carry, that the amount of bending due to the movement of the levers shall be well within the elastic limit of the material. The long arm of the lever, C, is coupled by the bar, D, with the short arm of the poise frame lever, E; the long arm of this lever carries all the standard weights of the scale and the method of putting them on or taking them off is peculiar to the Emery system. Suspended from this lever, E, at suitable intervals by thin fulcrum plates, are poise frames, N, consisting of an upper crosshead, S, and a lower crosshead, T, united by three vertical bars disposed at equal intervals about the crossheads.

These bars are provided on their inner faces with short projecting brackets, V, having a horizontal surface and a beveled surface, which correspond with similar surfaces formed on the weights, h, which are short cylinders or rings with beveled edges. The weights are carried by the flat surfaces and centered by the beveled surfaces. A weight frame, M, of the same construction has its three vertical bracketed bars alternating with the bars of the poise frame. This weight frame is guided and is raised and lowered in a vertical line without touching the poise frame by a rock shaft and hand lever, coupled to the rod projecting from the crosshead, R. The brackets on the weight frame bars are differently spaced from those on the poise frame, and when the weight frame is at the top of its stroke it carries all of the weights clear of the poise frame. A small movement downwards transfers one weight to the poise frame, the beveled surfaces on the brackets centering the weight if displaced sideways by a too sudden movement. A further movement transfers another, and so on; that is, the movement of the weight frame in either direction transfers the weights singly and successively from one frame to the other. In Fig. 1 the weights, f and g, are shown carried by the poise frame, j and k, by the weight frame, while h is being transferred from one to the other.

The operating hand lever is provided with a notched segment, into which a click spring plays so that the operator feels when he has moved the lever the right distance to transfer a weight without having to watch the indicator, as formerly, and the arrangement of the six bars surrounds the weights by a cage that effectually prevents any displacement and consequent interruption of the test, as sometimes occurred when the weights rested on simple shelves secured only by short pointed pins. There is hence no necessity for opening the glass case that incloses this part of the scale, and the weights are never exposed to any risk of alteration. The weights in the first poise frame have a value of 100 lbs.; the next frame carries weights of a value of ten times as much, or 1,000 lbs.; the next, 10,000 lbs., and so on; and the readings are summed up by a series of segments connected to the several operating shafts and provided with figures denoting the number of weights on each poise frame. A horizontal slot in a vertical plate, near the upper left-hand corner of the scale, is so placed that the reading of the figures shown through this slot denotes the number of pounds pressure applied to the specimen.

The final lever of the scale is an indicator needle, F, which has a movement at its point of 1¾ ins. to 2 ins., and this movement, calculated from the mechanical ratios of the hydraulic chambers and of the levers in the scale, is not less than 300,000 times the movement of the piston c in the first hydraulic chamber, and may on large machines be 6,000,000 times as much. The transfer of fluid from one chamber to the other is almost imperceptible; and while it takes force to move the metal sheets and to bend the steel fulcrums, yet this force is all returned as the various parts resume their position of equilibrium, the needle returning to the same zero point after being disturbed in either direction.

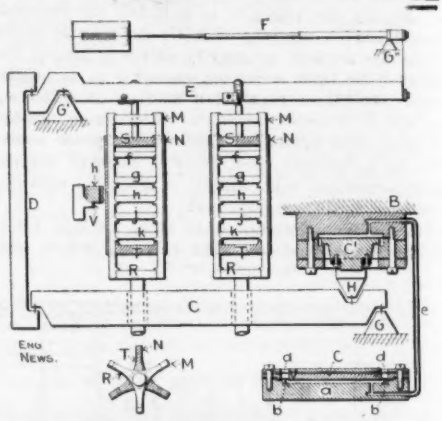


Fig. 2. Diagram Illustrating Action of the Emery Testing Machine.

The Emery testing machines are now made horizontal instead of vertical, in the first place to make all sizes of machines of one type, and in the second place to get certain advantages in overcoming the shocks of recoil. In all but the very smallest size of machines, the weighing head and the hydraulic cylinder or straining head are carried and alined by the top surface of a wrought iron bed.

The weighing head, Fig. 2, consists of two circular or annular beams, 65 and 69, firmly secured together by bolts placed around their periphery and by the straining screws, which pass through both beams and clamp them by a shoulder and nut. This head and the straining head fit easily upon the bed, which maintains the axes of the two heads in the same straight line. A drawbar, 70, is secured in the axis of these beams by two thin annular steel plates, 72, bolted against shoulders near the ends of the drawbar and secured firmly in recesses formed in the outside face of each beam. These plates hold the drawbar securely in line with the axis of the machine while permitting a free motion to a limited extent in the direction of the axis. The projecting end of the drawbar is provided with a screw thread, by which the compression platform or the tension holder is secured to it. The drawbar is enlarged in the middle, and against each of the two shoulders thus formed is secured a thin annular steel plate, 73; these plates are for the purpose of carrying and centering the hydraulic support, which is made annular, instead of circular, as shown in Fig. 1, and is placed centrally about the axis of the drawbar, so that end stress on the bar is resisted symmetrically by the hydraulic support, the part corresponding to the cylinder being secured to one plate and an abutment ring secured to the piston being secured to the other plate while the cylinder and piston are also separately coupled by flexible plates. By this means the hydraulic support is maintained in fixed relation with the drawbar laterally, while it is left free to move relatively to it in the direction of its axis through the small distance required. On each side of the hydraulic support, steel collars, 71, are screwed and secured to the drawbar; these collars are provided on the periphery with a series of ribs, parallel with the axis of the drawbar and which lie between without touching, similar ribs projecting from the interior surface of the annular beams. The ends of all these ribs on the two beams and the collars are accurately faced to true planes at right angles to the axis of the drawbar, and the distance between the two extreme faces of the hydraulic support is made slightly less than

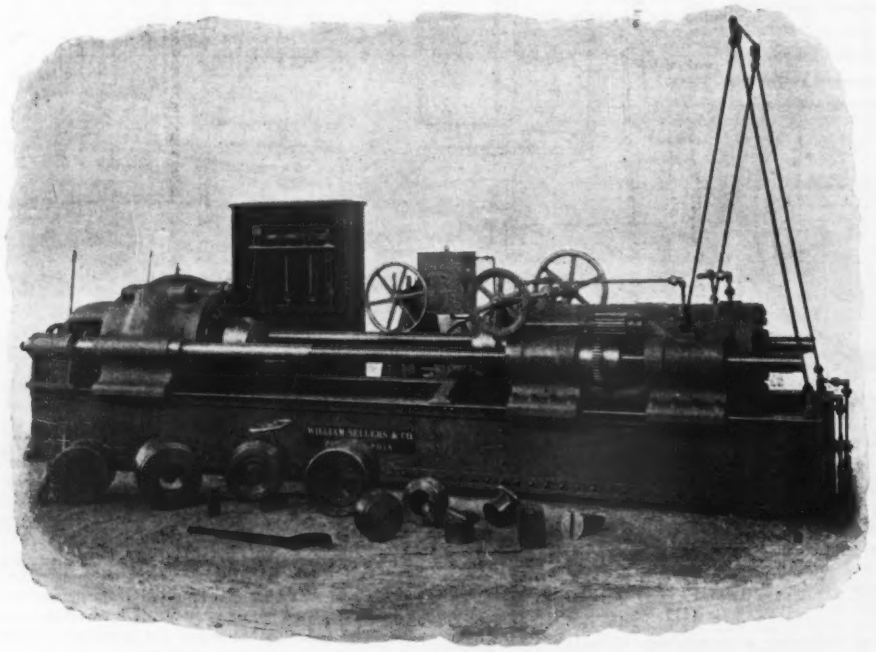


FIG. 1. PERSPECTIVE VIEW OF EMERY TESTING MACHINE.

* A paper read before members of the American Society of Mechanical Engineers, March 14, 1894.

the distance between those two planes. Movement of the drawbar in either direction carries the hydraulic support against the ends of the ribs in one annular beam and brings the ends of the ribs on one of the collars or the bar against the opposite side of the hydraulic support, and produces pressure on the contained liquid, which is transmitted through the pipe, 63, to the small hydraulic chamber in the scale. For the purpose of insuring that everything about

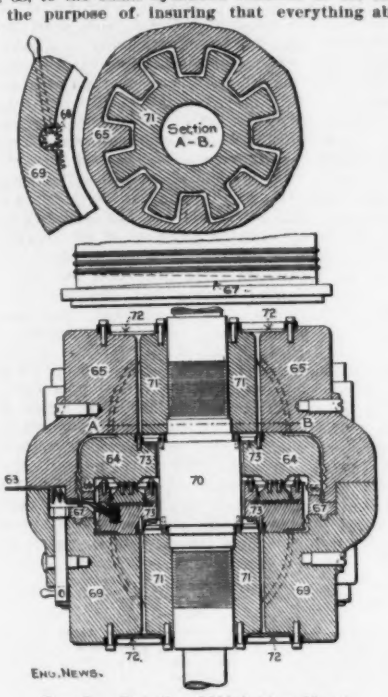


Fig. 3. Details of Weighing Head.

the hydraulic chamber has a solid bearing, it is necessary to produce an initial loading of about 5% of the maximum load, which is done by applying a definite spring pressure to move the drawbar in the direction in which the stress to be applied to the specimen will move it, and after this the scale is balanced in the usual way by sliding weights on the poise beam. In order to prevent the shock of recoil, resulting from the rupture of a large specimen of high steel, from doing injury to the thin brass plates in the hydraulic support, the abutting piece, 64, of the support which rests against the ribs in the annular beam, 65, when strains of tension are applied, is made larger in diameter than the hydraulic support proper, and is provided with a spiral or screw face, 66, which engages with a corresponding screw face formed on a rotatable ring, 67, fitting in the other annular beam, 69. After the initial load has been applied, this ring is rotated by the pinion shaft, 68, to bring the screw faces in contact, and the abutting piece, 64, is thus clamped firmly to the annular beam, against which it rests. When the specimen breaks, its first blow is delivered through the drawbar and ribbed collar to this abutting piece, 64, which transmits it through the ring, 67, to the rear annular beam, 69, and as these beams, 65 and 69, are rigidly united, the blow is absorbed by the total mass of these two beams. The hydraulic support is thus thoroughly protected and these machines can be used regularly for breaking high steel specimens up to the full capacity of the machine without any risk or injury.

The weighing head is returned to its place on the bed after movement due to recoil by a set of spiral springs locked up in boxes secured to the bed; these springs are strong enough to move the head, and their resistance diminishes greatly the movement due to recoil, while the friction of the head upon the bed rapidly wipes out the oscillations.

The annular beams bolted together, as described, constitute one built up beam to resist the bending due to the pressure on the drawbar midway between the straining screws. The hydraulic support is thus inclosed in a rigid mass of cast iron and effectually proteced against injury from violence or from being gummed up by oil from the straining cylinder, as has occurred with the upright machines, and the frictionless movement of this support under all conditions of service is thus insured. For very large machines when the annular support just described would become too large to be rated by the support testing machine, the supports are made circular and are grouped symmetrically about the axle of the drawbar.

Two straining screws, 77, are provided, see Fig. 3, fixed firmly to the weighing head and passing freely through bearings, 88, formed on each end of the straining head, 87. A revolving nut, 89, provided with gear teeth on its periphery, is placed on each straining screw between the two bearings, 88, formed on the sides of the straining head. These nuts are revolved by the wide face pinions, 90, driven through the bevel wheels, 92 and 93, by a balancing train of gearing, consisting of a gear wheel, 96, carrying two balancing bevel pinions. These mesh with two bevel wheels, one on each side of the first gear wheel, 96, so that power applied to the gear, 96, is by means of the balancing pinions divided equally between the two bevel wheels, and thus imparts equal pressure to the revolving nuts, 89, on the straining screws. This arrangement does away with the necessity heretofore existing of having the straining screws of exactly similar pitch throughout their length. With this construction the screws could be of different pitches, the alinement of the heads being secured by the fit of the screws in their bearings and of the heads on the wrought iron bed or shear. By driving this train of gearing either by hand or by power the straining head is moved back and forth upon the bed to accommodate the varying lengths of specimens. When the head is adjusted to place, the nuts form the abutments upon the screws to resist the movement of the cylinder for strains of compression or extension. The nuts, 89, do not fit snugly endwise as heretofore, but a space of several inches is left between the ends of the nuts, 89, and the faces of the bearings, 88. This provides for the shock of recoil when breaking a long and large specimen. The sudden release of the straining screws from their load when the specimen breaks, together with the force resulting from the sudden contraction of that end of the specimen attached to the straining head, merely give the head a push along the bed and it slides freely until its momentum is absorbed by its own friction, the space between the revolving nuts and the bearings allowing ample room for this travel under the best conditions of lubrication. This head is thus entirely cut off from the rapid vibrations of the straining screws, and the necessity of making the nuts an exceedingly good fit to both screw and head is entirely avoided.

The straining head is provided with a piston packed to receive fluid pressure in either direction, and the piston rod passing through a packed bearing in one end, is provided with a screw thread, similar to that on the drawbar, to receive the various holders. The fluid is applied to this straining cylinder through two systems of jointed pipes, which are connected through the valves at the scale case with the pressure pump, and the tank respectively, so that each pipe acts either as a pressure pipe or an exhaust pipe, depending upon the direction in which the strain is to be exerted upon the specimen.

The tension holder for gripping specimens for extension tests is shown in section in Fig. 4. A steel case consisting of the two parts, 99 and 107, united

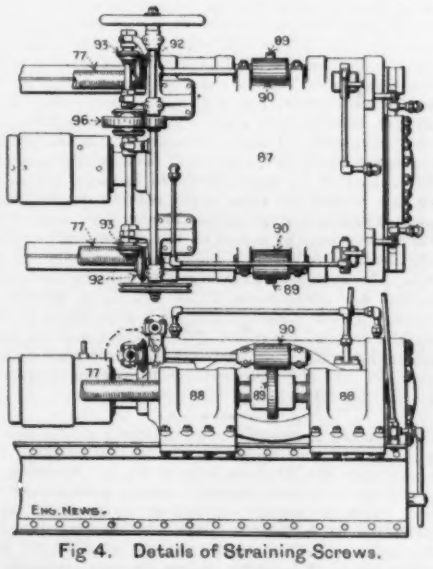


Fig 4. Details of Straining Screws.

by the nut 108, is secured to the end of the drawbar or piston rod by the screw thread described. The gripping jaws, 110, are two cylinders that slide freely in cylindrical holes bored in the case, 99, at an angle of about 20° with the axis of the case, making an angle of, say, 40° with each other, the axes of the jaws and of the case being in the same plane. The rear end of each of these jaws is provided with a T slot, lying in this plane and at right angles to the axis of the case, which engages with a T rib formed on a crosshead, 106, that fits in a bearing in the case and compels the jaws to move equally and simultaneously. The crosshead is provided with a screw thread in its interior to receive an abutment screw, 103, which forces the jaws forward and closes them upon the specimen. This screw is operated by an annular worm gear, 102, provided in its interior with two narrow lugs, which engage with two similar lugs formed on the abutment screw, so that the worm wheel could make almost a half revolution without moving the screw, to which it is coupled by

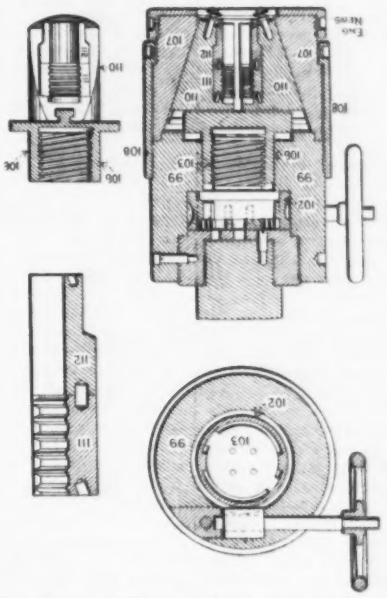


Fig. 5. Details of Gripping Mechanism for Tension Tests.

a strong spiral spring, Fig. 24. Cylindrical recesses are formed in the opposing faces of the jaws to receive the hardened steel gripping dies, 111 and 112, which are made of various sizes and shapes to receive flat, square or round specimens. The forward half of these dies, 112, is made parallel and smooth and of a shape to conform to the section of the specimen; following this the die, 111, has a series of alternate V-shaped ridges and grooves running transversely to the length of the specimen; the apex of the ridge next to the parallel die, 112, being truncated so that it stands a very little above the surface of the parallel die; the next ridge is truncated less and stands higher, and so on until the last ridge, which is left sharp, see Fig. 26. The dies are closed upon the specimen to be tested by turning the worm wheel, which, by means of the abutment screw, 103, and crosshead, 106, pushes the jaws forward until the sharp ridge on the dies rests against the specimen. Further revolution of the worm gear then winds up the spiral spring until the driving lugs on wheel and screw come in contact, when the sharp ridge is forced into the specimen sufficiently to insure that the friction between the dies and the specimen shall be greater than that between the jaws and the case. When stress is applied to the specimen, the jaws will be drawn forward, sinking these ridges successively into the specimen until the parallel part of the dies grip it firmly, the idea being that the parallel part will hold with more than sufficient friction to compensate for the depression made in the specimen in the first ridge, and so on to the last, so that a bar of metal can be put into this holder without any preparation and broken without any risk of being broken in the gripped part. As the jaws are drawn forward the spiral spring unwinds and keeps the abutment screw tightly pressed against the crosshead, holding it against the ends of the jaws, and taking up all lost motion, thus securing accurate centering and gripping of the specimen, no tearing strains, accuracy of weighing at all times, definite weights applied at each movement, and great rapidity for commercial testing. When the specimen breaks it will in all cases be firmly held in the dies and there will be no disturbance nor flying pieces, nor any noise beyond that of the broken piece itself.

A description of the testing machine would not be complete without a notice of the support testing machine, by which all of these testing machines are rated. This machine is made entirely of steel, in order to secure the greatest possible rigidity, and weighs some 45,000 lbs. It consists of a bed plate, on which are mounted two main levers, which carry a heavy platform about 40 ins. square. (Details of description omitted.—Ed.) All of the supports and cou-

nections of all the levers are the Emery flexible fulcrum plates, varying in thickness from about 0.005 in. at the needle to 3-16 in. at the platform, which is designed to carry 500,000 lbs. and has carried 600,000 lbs. without any signs of injury, the ratio from the platform to the point of the needle being 306,600 to 1. This large scale shows conclusively that the use of fulcrum plates instead of knife edges eliminates friction. A weight of 200 grains laid on the main platform puts in motion material weighing more than 25,000 lbs., and moves the needle 0.02 in., and in all of our experimental work on this machine we were unable to perceive any reduction in this sensitiveness when fully loaded. The same weights are used for the three platforms, being decreased in value for the small platforms by the ratio that they bear to the main platform, thus a 1,000-lb. weight in the scale balances 1 lb. on the 500-lb. platform, which turns with half a grain.

Pressure is applied to the platform of this scale by means of an upper platen movable by four large loading screws, carried by nuts bolted to the top plate by means of a large hand wheel and worm gear. These screws are operated with the greatest nicety, so that the pressure upon any object resting on the scale platform can be adjusted exactly. The main hydraulic support of every testing machine built by us is placed on this platform and connected with the reducing chamber in the scale which is to be used with the machine. Definite loads are then applied by means of the loading screws, and the weights in the poise frames of the testing machine scale carefully adjusted to correspond. In this way every machine is rated accurately by small increments of load up to its full capacity, nothing being taken for granted. For very large machines where the size of the annular hydraulic supports would be beyond the capacity of this machine, the supports are made circular and grouped around the drawbar as before described; and by testing these supports first separately and then collectively, a testing machine of, for example, 10,000 tons capacity, could be accurately rated throughout its full range, giving an absolute certainty as to results never before attained.

The original rating of this machine presented some very curious problems, which gave a great deal of trouble to solve, but ended in convincing us that while the machine is exceedingly sensitive to change of load, it is also, which is a rare combination, equally insensitive to rough usage, such as severe side strains and twists.

The method of rating proposed was to place a standard weight on the platform and balance it by small standard weights placed in one of the poise frames; then to remove this standard and apply pressure to the platform by means of the loading screws until the small weights were again balanced; then to replace the standard and see if it was again balanced by the same amount of small weights, the weighing of the machine being assumed to be correct if this standard weight would be balanced by the same small weights under all conditions of loading, and so on until the full capacity of the machine was reached.

The standard first used weighed a ton, and as the loads were applied by the screws its balancing weight fell off until it required only four-fifths of the small weights to balance it that it took when on the empty machine; in other words, it weighed but 1,600 lbs., and from that point on up to the full capacity of the scale, it weighed 1,600 lbs., neither more nor less. The first inference was that some part of the scale was not solidly fitted and that under this load it settled to place. An initial load of 30,000 lbs. was applied by steel bars placed so as to act as load springs but without producing any change in the action of the machine. The machine was then taken apart, but a very careful examination failed to detect any defect. Supposing that the defect might be too small to be readily discovered, an effort was made to exaggerate it and so locate it by packing the lever supports out of level and in-wind; the machine required rebalancing, of course, but nothing that we did disturbed the action of the weight, nor the sensitiveness of the scale, nor the regularity of weighing when the critical point was once passed. The screws and gearing actuating the platen were then thought to be at fault, although it was impossible to see how they could cause any disturbance, but in order to avoid any question, an hydraulic chamber 3 ft. in diameter was made and secured to the underside of the platen, and suspending bolts were provided so the platen could be adjusted closely to place by the screws and all lost motion taken up by the suspending bolts; pressure was applied by pumping liquid into this hydraulic chamber.

The results differed in no way from those previously obtained, but by this time I had determined what the cause of the trouble was, namely, that we had been trying to weigh two kinds of pressure without thinking that they might have different results. I therefore coupled this hydraulic cylinder to a testing machine scale, applied a pressure of about 150,000 lbs. on the platform of the support testing machine and put weights on the poise frames of the testing machine scale until its needle stood at zero. We then ran the ton weight on, and, as I expected, the needle on the scale immediately moved, indicating a reduction in the pressure. This reduction was produced by the very minute sinking of the platform when the ton weight was applied; keeping the weight on, the screws were adjusted until the needle stood again at zero, and then the ton weight required exactly the same amount to balance it as when it was put on the empty machine. This settled the whole question. We found the machine was right, its weighings regular under conditions of distortion that would have ruined an ordinary scale and that the whole trouble came from the fact that we had been trying to weigh screw pressure and pressure produced by gravity without taking into account the disturbance that one produced on the other.

The extreme sensitiveness of this machine serves to show how material supposed to be solid and rigid is in reality continually in motion. In one test the full pressure of 500,000 lbs. was put upon the platform and allowed to remain for 70 hours. At the end of this time, it had fallen off to 498,407 lbs., and the falling off still continued at the rate of about 1 lb. in ten minutes. The pressure was then reduced to 400,000 lbs. Instead of falling off the load increased 40 lbs. in three minutes, and after standing for ten minutes the load decreased at the rate of 7 lbs. in about five minutes. When the pressure was reduced to 300,000 lbs., the load increased 146 lbs. in nine minutes, with no further indication of increase or decrease for eleven minutes, when it began to fall off very slowly. The pressure was then reduced to 200,000 lbs. It increased 307 lbs. in five minutes and in nine minutes 370 lbs. At this point the load began to fall off very slowly. It would be very interesting to try if any lapse of time under load would finally bring these movements to rest, but there has been as yet no necessity for making the experiment.

The U. S. Navy Small Arms Board has been testing the new .236-in. magazine rifle at Newport. With charges of from 30 to 39 grams of smokeless powder a velocity as high as 2,600 ft. per second has been obtained. At a range of 100 ft. the new bullets penetrated 51⅞ ins. pine boards, or 19 ins. of dry oak. The steel plates of a torpedo boat were also easily pierced. The breech mechanism required with this gun must be able to stand a pressure of 50,000 lbs. per sq. in., or that resulting from a charge of 35 grs. of smokeless powder. This breech mechanism will necessarily be different from anything now in existence, and tests of designs will not take place for several months.

The remarkable high-speed Corliss engine at the Trenton Iron Works, which has been running since 1877 at a higher rotative speed than has probably ever been attempted by any releasing valve gear engine, was wrecked on Feb. 20 by the breaking of its valve gear, resulting in the racing of the engine and the bursting of the flywheel. The engine was built by the Corliss Steam Engine Co. and had a single cylinder 20 × 42 ins. It has been run steadily at 160 to 170 revolutions, giving a piston speed above 1,100 ft. per minute. The valve operating mechanism was somewhat modified from the ordinary Corliss pattern to permit the high speed, being made as light as possible. In 1893 the engine averaged 18 hours' run daily, driving a train of rolls which reduced 4½-in. billets to wire rods in one operation. The accident was caused by the breakage of a part of the cut-off gear, causing the steam to follow full stroke in the cylinder at one end. The engine at once began to gain in speed and before the throttle could be shut had reached a velocity which made it advisable for all hands in her vicinity to hunt for cover. The flywheel sent its fragments through the roof and high in the air when failure occurred, but did little damage to the building, and no one was injured.

The asphalt controversy in Philadelphia goes on apace, with the Trinidad asphalt in the lead at present. Director of Works Windrim says he has no objections to amending his specifications for asphalt paving so as to read "Trinidad asphalt, or asphalt as good, or superior," but he declines to make any experiments with Bermudez or other asphalt as yet untested by five years' use in Philadelphia, unless Councils command it and assume the responsibility. He also wants the Washington practice followed, of paying a sufficient price to make contractors repair all defects in paving as soon as discovered; and also of employing experts to test every cargo of asphalt used, even when these cargoes come from exactly the same spot. Meanwhile, as the specifications demand that all repairs to asphalt-paved streets shall be made with the same material originally used, the Pennsylvania Co., which paved the 42 miles of asphalt streets in Philadelphia, has a monopoly of all repairs, as no other company can buy Trinidad "lake" asphalt for use in that connection. The competing companies, however, are continuing the fight for recognition.

The question of abolishing grade crossings by elevating the railway tracks in the city of Chicago is troubling the officials of the Rock Island, Michigan Central, Lake Shore and other companies. The track-elevating committee of the city council has decided that 1½ miles of track must be elevated each year by each separate company and that work must be commenced by Aug. 4, 1894. The railway companies must change gas, water and sewer pipes at their own expense, pave the subways, etc. The question of land damages is the bone of contention. The city ordinance as passed makes the railway companies pay all damages, judgments, costs and expenses arising from the construction, maintenance, or use of the elevated structure; unless the damage is caused by change of grade south of 22d St. The railway companies, on their part, will not accept any ordinance which does not relieve them of the payment of all damages, and there the matter now rests. Mayor Hopkins also proposes to tax certain cable companies for their share in track elevation; arguing that they are the worst offenders in grade crossing slaughter, and will reap their share in the benefit from track elevation.

A municipal pipe foundry is proposed by the city of Cleveland, and estimates for it are now being prepared by the Director of the Board of Public Works. The avowed purpose of the city in establishing the plant is to "fight the pipe foundry trust," according to the local newspapers. The last contracts for pipe which the city let were placed at $17.50 and $19.50 per ton. If pipe makers may be believed, a municipal foundry will have to do some remarkably creditable work if it is to supply pipe at a lower figure.

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

BOSTON & NOVA SCOTIA COAL.—C. M. Odell, Ch. Engr., Mabou, Cape Breton, writes us that owing to the severe winter the grading of the extension from Orangedale station to Broad Cove mines will not be commenced until the last of April. The line will extend from Orangedale through Whycocomah, Skye Glen, Brookville, Glendyer, Mabou and Strathborne to Broad Cove, a distance of 35 miles, with a six-mile branch to Mabou Harbor. The work will include some very heavy earthwork, there being one cut of 70,000 cu. yds., light bridging, easy grades and curves. There will be one steel trestle 210 ft. long and 110 ft. high at center. The line will pass through a fine farming country. The county of Inverness grants free right of way and the Dominion government and the local government of Nova Scotia each a subsidy of $3,200 per mile, making a total of $224,000. The surveys have been completed and the right of way cleared throughout. Garson Purser & Co., St. Catherines, Ont., have the contract for the construction. The road is expected to be opened for traffic in September, 1895. An extension from Broad Cove mines to Mabou Harbor, 15 miles, and one from Broad Cove mines to Chimney Corner mines, 60 miles, are also projected, the latter being an extension of the present line now under construction.

CLEVELAND, LORAIN & WHEELING.—W. C. Jewett, Ch. Engr., Cleveland, writes us that contracts for the grading and masonry for the new line between Mallet Creek and Cleveland have been awarded as follows: Werneburg Bros., Pittsburg, Pa., sections 1 to 7 inclusive; Fergerson Contracting Co., Seymour, Ind., sections 8 to 24; A. M. Walsfer & Co., Brooklyn Village, O., sections 25 to 28.

DRUMMOND COUNTY.—We are informed that an extension of this line is now being made from St. Leonard to Chaudiere Junction, near Levis, Que., about 65 miles, of which 20 miles are already completed. About 80 miles of this road are now in operation, between St. Hyacinth and Nicollet. An extension is also being projected from Chaudiere Junction to Quebec, about 11 miles. When completed this road will be 30 miles shorter than any other line between Montreal and Quebec. Wm. Mitchell, Gen. Man., Drummonville, Que., has been the promoter of the line from its inception. There will be two bridges over the Du Chene River, one 1,100 ft. long and 105 ft. high; one over the Henry River, one over the Chaudiere River, 1,300 ft. long, and several smaller bridges. The maximum grade is 1%. Engr., J. H. Tessier.

FLINT & PERE MARQUETTE.—Wm. B. Sears, Ch. Engr., Saginaw, East Side, Mich., writes us that no extensions are contemplated at present except short spans for lumbering purposes and that these are generally graded by parties owning the timber, track laid by railway company and as soon as timber is cut off the track is taken up and transferred to a new road.—Concerning the proposed extension from Monroe to Toledo, Mr. Sears writes that the surveys have been completed and the right of way purchased, but the work has been indefinitely postponed and the company does not wish the subject agitated at present.

LEHIGH VALLEY.—This company has awarded a contract for about 200,000 cu. yds. of steam shovel excavation near South Broad St. crossing, Newark, N. J., to Brodhead & Hickey, Fairview, N. J.

QUEBEC, CENTRAL.—Bids are asked until April 10 for the grading and other work connected with the building of 50 miles (in 5 to 10-mile sections) of the Tring-Megantic branch of this railway. Plans and

specifications may be seen at the office of the contractors, Holt & Lukes, Sherbrooke, Que.

WASHINGTON & CHESAPEAKE BEACH.—The Washington "Star" of last week stated as follows: This road is now being constructed from Magruder Station, on the Baltimore & Potomac, near Landover, to Chesapeake Bay, a distance of 30 miles. Yesterday Messrs. Cogan & Co. began the work of excavation at Magruder's. There are at present 360 hands engaged in the construction of the road, and 22 cuts are now open in order to have the road in operation at an early date. The bridge over the Patuxent River will cost $12,000, and the iron has been shipped for it. At the beach on the bay a 150-ft. pier has been completed. Col. L. H. Hyer is chief engineer.

Projects and Surveys.

ATHENS & SOUTH WAVERLY.—Incorporated in Pennsylvania to build a railway four miles long from Athens to South Waverly, all in Bradford county, Pa.; capital stock, $40,000; Pres., Chas. Kellog, Athens, Pa.

BEAVER MEADOW & NEW BOSTON.—The Philadelphia "Press" states as follows: Arrangements are said to have been completed for building the Beaver Meadow & New Boston R. R. from Beaver Meadow and Treskow to New Boston, Pa., 20 miles, and the construction is soon to be commenced. It will connect with the Delaware, Susquehanna & Schuylkill at Beaver Meadow and with the Pennsylvania at New Boston. Directors: A. S. Van Wickle, A. M. Eby, C. J. Kirschner, J. F. Barber, W. L. Chamberlain and Philip Weaver, of Hazleton, Pa., and B. W. Wilde, of Minesville, Pa.

CAMMAL & BLACK FOREST.—Incorporated in Pennsylvania to build a railway from Cammal, on the Fall Brook, to County Line Springs, a distance of about 15 miles; capital stock, $150,000; Pres. Robt. McCullough, Jersey Shore, Pa.

CHICAGO, UNION CITY & CINCINNATI.—This company has filed a mortgage for $900,000 to secure an issue of bonds for the construction of its proposed road, the contract for which has been awarded to J. J. Shaffer, Chicago, as stated in our issue of Feb. 15. Secy. and Treas., G. W. Patchell, Union City, Ind.

CLEARFIELD & CONEMAUGH.—Incorporated in Pennsylvania to build a railway from Belsena, Clearfield county, up Conemaugh Valley to Johnstown, on the Baltimore & Ohio, a distance of 60 miles; capital stock, $1,350,000; Pres., Samuel J. M. McCarell, Harrisburg; J. M. Cooper, G. D. Prentice, C. H. Sachrider, Pittsburg; T. F. Lingister, Johnson City, Tenn.; B. F. Myers, David Fleming, Harrisburg.

COLUMBIA & MARYLAND.—A bill has been introduced in the house at Annapolis, Md., authorizing this company to increase its capital stock to $10,000,000 and to build a steam or electric railway from Washington to Laurel and to extend the same from Laurel to the Pennsylvania state line.

HANOVER & NEWPORT.—Incorporated in Pennsylvania to build a railway from near Plymouth Station, on the Lackawanna & Bloomsburg, in Luzerne county, in a southerly and westerly direction across the Susquehanna River to Newport Center, with a branch from near Dundee Shaft in Hanover township, and extending about two miles southwesterly to Hanover Station, on the Nanticoke Branch of the Central R. R. of New Jersey; length of road, 10.58 miles; capital stock, $500,000; Pres., Wm. F. Hallstead, Scranton, Pa.; G. M. Hallstead, M. L. Corbit, J. W. Fowler, W. H. Storrs, J. F. Snyder and others of Scranton, Pa.

MAINE SHORE LINE.—The Boston "Herald" states as follows: Capitalists are discussing the construction of a new railway line in Maine, to be called The Shore Line. It will leave the Maine Central at Franklin, and run through Steuben, Harrington, Cherryfield, Columbia Falls, Jonesboro, Dennisville, Machias and East Pembroke to Eastport, a distance of 112 miles, furnishing an outlet to a large lumber district, a considerable manufacturing population, and a large number of summer resorts. The promoters profess to be sanguine of the forthcoming of capital, and the construction of the road the coming season. Gen. S. D. Leavitt, Eastport, Me., and Judge I. G. Downes, Calais, Me., are interested.

MASSACHUSETTS.—The legislature has been petitioned for a charter for a company to construct the proposed railway along the South Shore from Falmouth to Hyannis, Mass. The project was noted Oct. 12 under Old Colony, as the line would connect with that railway at each terminus. The proposed incorporators include Francis W. Parsons, Osterville; C. H. Nye, formerly Supt. Cape Cod division of the Old Colony; Wm. N. Kellen, S. L. Leonard, Winslow Warren, Boston; and Frank A. Nye, North Falmouth. The route selected lies almost wholly through unimproved lands and over two-thirds of the right of way is said to have been already donated.

NIPISSING & JAMES' BAY.—The survey for this proposed railway, 360 miles in length, was the subject of a paper recently read by J. A. Paterson, Engr., before the Association of Ontario Land Surveyors, at Toronto.

Southern—Existing Roads.

ATLANTIC, SUWANEE RIVER & GLF.—It is stated that the contract for grading this railway from La Crosse, Fla., west to the Suwanee River, 35 miles, has been awarded to Wm. Varnadoe and that the work will soon be commenced. Ch. Engr., F. G. Moorhead, Ocala, Fla.

GAINESVILLE, ROCKY POINT & MICANOPY.—Six miles of grading have been completed on this railway from Gainesville, Fla., and tracklaying has been commenced, according to reports. The line will be continued to Micanopy, 12 miles, and the work will require two miles of trestles. Vice-Pres., J. M. Graham, Gainesville, Fla.

Projects and Surveys.

RICHMOND & MANASSAS.—The "Manufacturers' Record," Baltimore, has received information from a capitalist at Richmond, Va., directly interested in this projected railway, that the actual construction work on the line will begin in a short time. The parties interested have secured all the charters of existing and projected roads between Richmond and Ridgeway, N. C. At the latter place a connection will be made with the Seaboard Air Line, and at Manassas with the Metropolitan branch of the Baltimore & Ohio now being built, thus forming a through line between the North and South.

Northwest—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—Press reports state that this company will build a cut-off on its Omaha-Texas line, between Beatrice, Neb., and Herrington, Kan. This would reduce the distance between Omaha and Fort Worth from 748 to 648 miles. At present it runs from Omaha through Lincoln, Jensen and Fairburg to Belleville, thence to McFarland, Herrington and to Fort Worth. The new line would be from Beatrice straight across to Herrington, or, perhaps, from Beatrice to Manhattan, Kan.

NORTHERN PACIFIC.—The city of Ortonville, Minn., has voted to issue $20,000 of bonds as a bonus for an extension of this railway from Morris to that city.

ST. LOUIS & EASTERN.—It is reported that the greater part of the right of way has been secured for an extension from Maine, Ill., north to Alhambra.

WISCONSIN & MICHIGAN.—A press report from Menominee, Mich., states as follows: Several weeks ago it was announced that this company had purchased the roadbed of the Ingalls & White Rapids narrow gage logging road, which roadbed the new organization was to utilize in the construction of its line from the mouth of the Menominee River up into the extensive pine tracts in northern Wisconsin and upper Michigan. John Bagley, Chicago, was the owner of the narrow gage logging road, and he is also the main organizer of the Wisconsin & Michigan. The new road will not at present be built from either this city or Marinette, as planned, but will start from near Porterfield Station, on the Ellis Junction branch of the Chicago, Milwaukee & St. Paul, in Wisconsin, running north and east and crossing the Menominee River into Michigan, about a mile above the Grand Rapids, near Ingalls, on the Northwestern, and proceeds north to the Soo road, which it intersects at a point four miles west of Hermansville. The rails are now being laid on the bridge over the Menominee River, and the narrow gage logging road is rapidly being changed to standard gage. A seven-mile branch to Peshtigo is also a certainty.

Projects and Surveys.

PELLA & NEW SHARON.—A correspondent writes us that the survey for this road to connect the Iowa Central and Wabash railways was commenced March 8. The first survey starts from the Iowa Central, at Oskaloosa, Ia., passes through Pella and will connect with the Wabash between Howell and Fiefield. The second survey will be from New Sharon through Pella to the Wabash. Pres., Liston McMillan; Ch. Engr., H. Byers, Oskaloosa, Ia.

Southwest—Existing Roads.

KANSAS CITY, ARKANSAS & NEW ORLEANS.—This road has been graded for 47 miles south of Hozen, Ark., and it is reported that 60-lb. steel rails have been purchased for completing the line between Stuttgart and Bruner, Ark. Gen. Man., G. D. Foster, Stuttgart, Ark.

Projects and Surveys.

LAKE SUPERIOR, SOUTHWESTERN & GULF.—It is stated that the contract for constructing 100 miles of this railway has been sublet to Col. J. H. McCarthy, Little Rock, Ark., and that the general offices and shops will be located in that city.

ST. LOUIS, AVOYELLES & SOUTHWESTERN.—Ira W. Sylvester, Ch. Engr., Alexandria, La., is reported as stating that this road will be built from Bunkie, La., on the Texas & Pacific, northeasterly about thirty miles to the Red River. The route has been surveyed and the work will be pushed as rapidly as possible.

Rocky Mt. and Pacific—Existing Roads.

COLORADO.—Press reports from Colorado Springs state that plans have been completed in that city for the construction of a railway from Colorado Springs to Cripple Creek by way of Bear Creek Canyon, a distance of 29 miles. For 8½ miles it will be necessary to use the cog system now in successful operation on the road up Pike's Peak. The cost of construction and equipment is estimated at $750,000.

MONTANA.—The Butte "Inter-Mountain" states that work will be commenced this spring on a railway to be built from Jocko, on the main line of the Northern Pacific, near Missoula, through the Flathead Valley and to the coal fields beyond Columbia Falls. A local company will be organized at Butte to start the work. J. A. Talbott and A. J. Davis and others, of Butte, are interested in coal lands in the section to which the railway is to be built.

NEVADA.—A press report from Lovelock, Nev., states as follows: C. C. Fitzgerald, one of the best-known mining men in South America, accompanied by C. D. Norris, of the Pennsylvania R. R., departed this morning for Clemens, 30 miles distant, to begin a survey and make estimates for a standard gage railway from the copper mines at White Cloud to the Central Pacific. A corps of surveyors will leave Clemens to-morrow with Lovelock as the objective point and junction of roads.

PAYETTE VALLEY & NORTHERN.—The citizens of Payette, Idaho, are reported to have subscribed $90,000, which is expected to be increased to $125,000, as a bonus for a railway 110 miles in length, into the Seven Devils mining district. This company, the Payette, Salubria & Northern and the Weiser & Northern have been incorporated within a few years to build a railway from the Oregon Short Line north to this region, and it is thought that the liberal bonus offered by Payette will secure that as the junction city, whichever company builds the road.

SAN FRANCISCO & WEST SHORE.—A press report from Half Moon Bay, Cal., states that John W. Eisenhuth has commenced the construction of this railway at a place near the Point San Pedro fog signal station, eight miles north of that city, and that it is proposed to build the road into San Francisco and south to Pescadero as quickly as possible. This has been reported as a part of the San Francisco & Atlantic project, of which Frederick Homer is the chief promoter.

TOLEDO R. R. & IMPROVEMENT.—Incorporated in Washington to build a railway from Toledo to some place on the Northern Pacific; capital stock, $80,000; Pres., F. H. Thorne; Secy., G. W. Denny; Treas., E. P. Badger.

STREET AND ELECTRIC RAILWAYS.

BURLINGTON, VT.—The Winooski & Burlington St. Ry. Co. is reported as planning to extend its electric railway to Queen City Park this spring.

HOLYOKE, MASS.—A franchise has been granted to the People's Electric St. Ry. Co. for a street railway 9.23 miles in length.

SPRINGFIELD, MASS.—The stockholders of the street railway company have voted to petition the councils of this city and Chicopee for permission to make extensions estimated to cost $30,000.

NEW BRITAIN, CONN.—The Central Ry. & Electric Co. is reported as receiving bids for extending its South Main St. line.

BROOKLYN, N. Y.—Press reports state that the Nassau Electric R. R. Co. has contracted with W. A. Boland, Boston, for the construction of its 100 miles of electric railway in this city and vicinity. The Johnson Steel Co. has the contract for the steel rails and 500 tons have already been delivered. It is intended to have the entire system in operation within a year. The company was incorporated some time ago with a capital stock of $12,000,000, by P. H. Flynn, Pres., Brooklyn; Congressman T. Johnson and A. L. Johnson, Cleveland; R. T. Wilson, New York; W. A. Boland, Boston, and others.

DANSVILLE, N. Y.—It is stated that a contract will soon be awarded for an electric street railway. Address, Dr. Jas. H. Jackson.

FLUSHING, N. Y.—The Brooklyn City R. R. Co. has been granted a franchise in this village.

NEW YORK, N. Y.—The Metropolitan Traction Co. has been granted a franchise to extend its cable system through 53d St. from Broadway to Ninth Ave. This will permit an uninterrupted trip from the Battery to Harlem.

RAHWAY, N. J.—The Rahway Electric St. R. R. Co. has been granted an additional three months in which to lay its tracks through the city. The company asked for a year.

READING, PA.—The Reading & Womelsdorf Electric Ry. Co. has been incorporated; capital stock, $30,000; Pres., John A. Rigg.

BALTIMORE, MD.—J. F. Waggaman, Washington, and R. D. Carter, Harry Hebden, D. C. Bennett and A. J. Robinson, Baltimore, have petitioned for a franchise for the Baltimore & Loreley Ry. Co. to build an electric railway; capital stock, $300,000.

COLUMBIA, S. C.—The Land & Electric Ry. Co. is arranging to extend its street railway to the suburb of Kleinbeck.

CLEVELAND, O.—The Ohio Inter-Urban R. R. Co. has been incorporated to build an electric railway; capital stock, $200,000; incorporators, J. L. Mauldin, J. B. Christ, Clayton Chapman, C. L. Saunders, Frank J. Lewis and W. B. Scorer.

DAYTON, O.—The City Ry. Co. has purchased a site on the West Side and will erect a central power house there.

TOLEDO, O.—The Toledo Terminal R. R. Co., capital stock $50,000, and the Toledo, Maumee & Perrysburg Electric St. Ry. Co., capital stock $150,000, have been incorporated.

DETROIT, MICH.—The City & Suburban Traction Co. has been granted a franchise by the township board of Springwells for an electric street railway on Michigan Ave. from the city limits to the Dearborn line.

CHICAGO, ILL.—The Chicago Central Sub-Railroad Co. has been incorporated by Marcus Poliaski, Masmer, and Wm. M. Northrup, Chicago; Wm. H. Llewellyn, Seattle, and A. M. Low, Detroit; capital stock, $15,000,000.

PINCKNEYVILLE, ILL.—The Pinckneyville St. Car R. R. Co. has been incorporated; capital stock, $4,000; incorporators, Herman C. Hanke, Philip Gruner, Henry Driemayer, H. P. Huntsinger and W. R. Murphy.

KENOSHA, WIS.—A franchise has been granted to F. M. Kringle, work to be commenced within 60 days.

SIOUX CITY, IA.—J. H. Quick is reported as stating that the City & Morning Side St. Ry. will be built if a franchise is secured.

KANSAS CITY, MO.—The Kansas City Suburban Belt Ry. Co. has increased its capital stock from $2,750,000 to $4,750,000.

ST. LOUIS, MO.—The Baden & St. Louis Ry. Co. has voted to change the motive power of its line, 3½ miles long, from horses to electricity at once.

FORT SMITH, ARK.—The Fort Smith & Van Buren Bridge Electric Ry. & Light Co. was incorporated at Jersey City, N. J., March 15; capital stock, $1,000,000; F. M. Stratton and W. E. Jennings, 143 Liberty St., New York, are interested.

SHERMAN, TEX.—The College Hills & Park Electric Ry. Co. has been incorporated by J. P. Harrison and others; capital stock, $100,000.

PORTLAND, ORE.—The Portland Traction Co. has been incorporated by Isaac Hecht, S. Prentiss Smith, F. L. Brown, S. Schwabacher and T. N. Strong; capital stock, $400,000; principal office, San Francisco.

MONTREAL, QUE.—The street railway company is reported as to spend $1,000,000 in extending its electric system this year.

ELEVATED RAILWAYS.

PHILADELPHIA, PA.—The Central Electric Elevated St. Ry. Co. has been incorporated to build an elevated railway from the north side of Pine St. opposite Barnwell St. to Bustleton; capital stock, $200,000; Pres., Wm. D. Marks, 508 Walnut St.

HIGHWAYS.

TENNESSEE.—The Jackson board of trade has adopted resolutions opposing any candidate for magistrate who is not in favor of graveling the roads in Madison county.

OHIO.—Bids are asked until April 25 for grading and macadamizing the Gahanna Cemetery Road, 2,000 lin. ft. H. J. Caren, Co. Aud., Columbus.——Bids are asked until April 10 for grading and macadamizing the Cedar Point Road, Oregon township, Lucas county. C. H. Jones, Co. Aud., Toledo.——Bids are asked by the commissioners of Hamilton county, Cincinnati, until April 7 for improving Carthage Pike Road, Mill Creek township.

WISCONSIN.—The commissioners of Barron county have appointed a committee with authority to purchase 15 road machines for different townships in the county, according to press reports.

NEBRASKA.—The commissioners of Douglass county, Omaha, have directed the clerk to advertise for 30 days for bids for $150,000 of paving with asphalt, stone blocks, brick or macadam.

COLORADO.—A committee from Fort Collins will petition the commissioners of Larimer county for the construction of a wagon road from that place to North Park, by way of Cherokee Park and Sand Creek Pass.

BRIDGES AND TUNNELS.

MANCHESTER N. H.—It is stated that bridge companies have been asked to submit plans and estimates for certain bridges in this city.

BOSTON, MASS.—The following bids were received for building a draw foundation and fender piers for the Dover St. bridge: W. L. Miller, $26,375; Trumbull & Ryan, $30,500; Perkins & White, $26,400; R. S. Randle, $38,817; C. H. Cavanaugh, $30,900; Alexander McInnis, $37,975; Joseph Ross, $34,995. The bids for building the steel superstructure are given under Contract Prices.

LOWELL, MASS.—It is reported probable that a new bridge will soon be constructed across the Merrimac River at Moody St.

LONG ISLAND CITY, N. Y.—A bill authorizing the construction of the proposed tunnel under Newton Creek to connect Manhattan Ave., Greenpoint, with Vernon Ave., this city, has been introduced in the legislature; estimated cost, $750,000.

NEW YORK, N. Y.—The state senate has passed a bill authorizing an expenditure of $2,000,000 for a bridge across the Harlem River at Willis Ave.——The president has signed the bill authorizing Austin Corbin and others to build a bridge across the East River between this city and Long Island City, noted last week.

PHILADELPHIA, PA.—Efforts are being made to secure a new bridge at Gray's Ferry. The plans provide for a double-decked iron bridge 60 ft. wide and estimated to cost $350,000.——The $3,000,000 loan ordinance included $740,000 for new bridges.

CINCINNATI, O.—It is claimed here that the Baltimore & Ohio Southwestern Ry. Co. has awarded contracts for 33 new iron bridges.

COLUMBUS, O.—The contract for the superstructure of the Front St. bridge has been awarded to the Edge Moor Bridge Wks., at $54,000.

MILWAUKEE, WIS.—G. H. Benzenberg, Cy. Engr., writes us that the Wisconsin Bridge & Iron Co. bid from $25,500 to $30,000 and the Schultz Bridge & Iron Co. from $24,800 to $42,000 for the superstructure of a folding or rolling lift bridge with two side spans across the North Menominee canal; each company presenting four plans and bidding $2,500 extra for electric motors.

HASTINGS, MINN.—It is reported that a new wagon bridge will be built across the Mississippi River at this place.

ST. PAUL, MINN.—Merryman & Phillips, Engrs. of the proposed bridge at South St. Paul, noted March 8, are reported as stating that no contracts have been awarded for the work, but that it is understood that the money needed for the construction has been secured.

MACON, MO.—The Macon county court has appropriated $5,000 for building two new iron bridges over the Chariton River, in this county, one west of La Plata and the other in Valley township.

ASTORIA, ORE.—The secretary of war has approved the plans for the proposed railway bridge across Young's Bay.

WINNIPEG, MAN.—The contract for the masonry piers for the proposed bridge at Boundary St. has been awarded to John Gunn & Co., $17,050.

BROCKVILLE, ONT.—Press reports state that the secretary of state at Washington has approved the plans for a proposed bridge across the St. Lawrence River from this place to Morristown, N. Y. The bridge will be 5,004 ft. in length and is estimated to cost $2,500,000. Plans are on file at the U. S. Engineer Office at Burlington, Vt.

OAKVILLE, ONT.—It is stated that the county engineer, at Toronto, has prepared plans for a swing bridge to be built over the harbor on Colborne St. in this town.

RENFREW, ONT.—The council has engaged J. L. Morris to prepare plans for a new bridge across the Bonnechere River in this village.

WATER-WORKS.

NEWPORT, N. H.—The town has voted to raise $60,000 for putting in works. J. B. Cooper, Comr.

BURLINGTON, VT.—Bids are asked until April 9 for the construction of a pump house and pumping plant complete at Fort Ethan Allen. Capt. Guy Howard, Asst. Q.-M., U. S. A.

ATTLEBORO, MASS.—The town has been granted authority to issue $50,000 of additional water bonds.

CHESTER, MASS.—The judiciary committee has reported favorbly a bill authorizing an issue of $30,000 of 6% bonds for works.

LEICESTER, MASS.—The town has voted to put in 25 hydrants in Cherry Valley and the extension will probably be made as soon as the frost is out of the ground.

METHUEN, MASS.—The town has voted to issue $100,000 of 30-year 4% water bonds.

NORTHAMPTON, MASS.—Bids are asked until April 3 for constructing a masonry dam, as stated in our advertising columns. W. W. Strong, Cy. Engr.

NORWOOD, MASS.—The town has been authorized to issue $20,000 of bonds for extensions.

BRIDGEPORT, CONN.—The committee will recommend the purchase of the plant, according to reports.

WATERBURY, CONN.—Bids are asked until April 6 for constructing masonry dam, as stated in our advertising columns. R. A. Cairns, Cy. Engr.

WATERBURY, CONN.—The contract for Section 2 of the 36-in. conduit has been awarded to Chas. Thatcher & Co., Waterbury, at $39,528, the other bids being Edward McManus, $39,914; A. H. Conn & J. D. Mooney, $40,227; J. P. Flynn & J. P. Sullivan, $41,502; Inman Bros., $41,441; Martin Lipps, $43,372. The bids previously received for this work were published Feb. 22.——The contract for gates and valves has been awarded to the Ludlow Valve Co., at $5,515. The Chapman Valve Mfg. Co. bid $6,429.

ANGELICA, N. Y.—It is stated that a private company stands ready to invest $30,000 in works if a franchise is secured.

NIAGARA FALLS, N. Y.—Bids are asked until March 30 for 20 to 12-in. extensions, as stated in our advertising columns. E. Z. Burns, Cy. Engr.

PENN YAN, N. Y.—The citizens have voted, 339 to 87, in favor of works.

SYRACUSE, N. Y.—Bids are asked until April 6 for 3,675 tons of pipe, as stated in our advertising columns. W. R. Hill, Cy. Engr.

TROY, N. Y.—The report of Prof. W. G. Raymond on the proposed new water supply includes the following estimates: Diverting dam, $21,219; Hakes reservoir, $65,930; Martin reservoir, $103,885; mill and second ponds, $21,103; Slaver pond, $18,387; Long pond, $4,868; total reservoirs, $235,392; pipe line, $160,000; contingencies and engineering, 10%, $39,539; total construction, $134,931; land, less value of timber, $12,267; riparian damages, $60,000; total expenditures, $507,198.

ASBURY PARK, N. J.—Bids are asked until April 2 for a filtering plant, as stated in our advertising columns. P. N. Black, Engr.

MATAWAN, N. J.—It is reported that there is no apparent opposition to the construction of works.

EAST GREENVILLE, PA.—Works will soon be put in, according to reports.

GETTYSBURG, PA.—The water company has purchased a site for a reservoir about three miles distant, where it is stated that a pumping station and filter plant will be located; estimated cost, $16,000.

HARRISBURG, PA.—The council is again considering the question of a filter plant.

MORRISVILLE, PA.—It is stated that the construction of works will be commenced about May 1.

MOUNT HOLLY, PA.—The town council is reported as in favor of works.

PHILADELPHIA, PA.—A bill has been introduced in council appropriating $5,000 and providing for the appointment of a committee of five to investigate the question of a new supply and to report within three months.

SALTSBURG, PA.—Robt. H. Wilson, Engr., informs us that the following bids were received for the complete construction of the proposed works: Bennett & Talbott, Greensburg, $14,389; Jas. McConegly, Jeannette, $13,700; Chandley Bros. & Co., Beaver Falls, $12,380; Kay & Coon, Bellwood, $12,378; Hallock Bros., Wheeling, W. Va., $13,870; J. W. Kelley, New Brighton, $11,845; McCormick & Moran, Agts., $16,500. Some of the itemized bids received are noted under Contract Prices.

WASHINGTON, D. C.—The district commissioners will receive bids until April 14 for a pumping engine and boilers.

FARMVILLE, VA.—W. P. Dupuy, and others, of Roanoke, have been granted a franchise.

QUITMAN, GA.—The contract for works has been awarded to J. W. Taylor, representing the Stilwell-Bierce & Smith Valle Co., at $14,185, according to press reports.

MIDDLEBURG, FLA.—It is stated that works will be put in.

KNOXVILLE, TENN.—The Knoxville Water Co. is reported as about to build a stand-pipe and filter plant; estimated cost, $53,000.

TALLAHOMA, TENN.—Geo. W. Davidson, Cy. Recdr., writes us that the council has not yet decided when works will be put in.

CLOVERPORT, KY.—D. R. Murray and F. J. Ferry are reported as interested in a proposed company to put in works.

LANCASTER, KY.—Bids are asked until May 1 for constructing works and an electric light plant. Fred Balcom, 627 Walnut St., Philadelphia.

CHICAGO, O.—Reports state that works are under discussion at Chicago Junction.

JAMESTOWN, O.—It is reported that the citizens have decided to secure works.

MANSFIELD, O.—The committee has reported in favor of the meter system, according to press reports.

ORVILLE, O.—The city received 11 bids for constructing the proposed works, the lowest being Snyder & Williams, Dayton, O., $20,321; H. D. Shannon, Orville (awarded contract), $20,325; Jesse Goode, Orville, $20,366; Jacob Eshilman, $20,455; Carrathers & Crane, $20,660. Highest bid, $22,472; Engineer's estimate, $21,490. Gordon compound duplex pumps; Mathews hydrants; Ludlow valves, and Lake Shore Foundry pipe will be used. Engr., Alexander Potter, New York.

SPRINGFIELD, O.—A bill has been introduced in the legislature authorizing the city to issue $125,000 of bonds for a new pumping engine and for extensions.

ALEXANDRIA, IND.—A Cincinnati paper states that bids will be received for constructing works at this place.

LEBANON, IND.—The contract for works has been awarded to Bynum, Brenton & Fall, at $47,885.

GIRARD, ILL.—The Girard Water Co. has been incorporated by R. C. Harper, W. H. Bairslow and Lester Soule; capital stock, $60,000.

GLENCOE, ILL.—Bids are asked until March 30 for works, as stated in our advertising columns. J. L. Day, Vil. Ck.

QUINCY, ILL.—J. F. Witmer, Buffalo, N. Y., has completed estimates for works, including 9,250 tons of pipe, at $18 per ton; one mile of 36-in. intake pipe and inlet well, $42,240; filters, $25,000; total, $456,000.

RUSHVILLE, ILL.—Bids are asked until April 10 for constructing works, as stated in our advertising columns. Chas. B. Griffith, Clk. Com.

BERLIN, WIS.—The council has granted a franchise to J. L. Beetis, J. W. Brown and others to put in works the city to take 90 hydrants at $38,888 per year each.

THORP, WIS.—An election will be held March 31 to vote on an issue of bonds for works.

BRITT, IA.—The citizens have voted to issue $7,500 of bonds for works. J. M. Coutts, Cy. Recdr.

ELDORA, IA.—Fremont Turner, Des Moines, has been awarded the contract for a stand-pipe at this place.

FORT DODGE, IA.—The mayor has recommended that an engineer be engaged to prepare plans for the improvements for which $16,000 of bonds were recently sold.

PELLA, IA.—The question of works continues to be discussed.

CALEDONIA, MINN.—Bids are asked until May 1 for $8,000 of 6% water-works bonds. E. K. Roverud, Cy. Recdr.

CLARA CITY, MINN.—The citizens have voted to issue bonds for works, according to reports.

DULUTH, MINN.—The city has been restrained by temporary injunction from selling the $800,000 of water bonds for new works.

HUTCHINSON, MINN.—An engineer has been engaged to prepare plans for works and an electric light plant, according to reports.

CONCORDIA, KAN.—Bids are asked until April 9 for a pumping plant, as stated in our advertising columns. J. H. Tyner, Cy. Clk.

AUBURN, NEB.—C. O. Snow, Cy. Clk., writes us that the contract for works has been awarded to E. A. Rudiger, Nebraska City, at $15,400. About 26 bids were received for material and parts of the work, the other bids for the complete work being Pomerene & Cooper, Lincoln, $16,746; Iowa Construction Co., Sioux City, $16,800; Fremont Foundry & Machine Co., Fremont, $16,765; Gaylord & Charlemorth, Shenandoah, Ia., $17,500. Engr., A. A. Richardson, Lincoln.

PENDER, NEB.—An election will be held April 17 to vote on an issue of $10,000 of 6% bonds for works.

NORMAN, OKLA.—It is stated that ground has been broken for works.

COLORADO SPRINGS, COLO.—The council has purchased the first water right in Fountain Creek for $11,000, which is said to furnish 25% more than the present consumption.

ERIE, COLO.—The town is reported as negotiating the sale of water bonds.

FLORENCE, COLO.—The survey for works has been completed and it is stated that the construction will be commenced as soon as a franchise has been secured.

GRAND JUNCTION, COLO.—There is talk of issuing bonds for works, according to reports.

ALBUQUERQUE, N. MEX.—The citizens have voted to extend the franchise of the water company five years.

LA GRANDE, ORE.—It is reported that an election will soon be held to vote on an issue of $50,000 of bonds for extensions.

SANTA CLARA, CAL.—The city is said to be figuring on a municipal plant for both water-works and electric lights.

QUEBEC, QUE.—Bids are asked until April 10 for iron and brass castings, lead pipe, etc., for one year. Jer. Gallagher, W.-W. Engr.

ARTESIAN WELLS.

CARSONVILLE, MICH.—Press reports state that additional wells will be sunk for fire protection.

SAGINAW, MICH.—At a recent meeting of the board of trade $1,000 was raised toward sinking a deep well.

BORNE, IA.—R. M. Mitchell, Cy. Engr., writes us that three bids were received for boring a proposed well, and that as these were very indefinite, they were rejected and that the work will be readvertised.

IRRIGATION.

LONE PINE, NEB.—A meeting was recently held at this place to discuss the proposed canal through the counties of Sheridan, Cherry, Brown, Rock and Holt. The temporary survey, made by A. J. Meals, of O'Neill, estimates the cost of the project at $2,000,000 and the number of acres to be irrigated at 1,500,000. The permanent survey is expected to be commenced about April 1.

EL PASO, TEX.—Bids are asked until April 15 for constructing irrigation dams and canals, as stated in our advertising columns. E. V. Berrien, Secy.

LOVELAND, COLO.—A press report states as follows: The Loveland & Greeley Irrigation Co. has contracted for reservoir near this place of 600,000,000 cu. ft. capacity. There will be 300 water rights for sale at $400 each for 80 acres of land. Water will have to pass through one tunnel of 3,000 ft., 2,000 of which is through sandstone, to pass from the reservoir to the canal.

BOONE, IA.—R. M. Mitchell, Cy. Engr., writes us writes us that the $250,000 of bonds have been sold to I. E. Doty, of Nebraska, at 91 cts., and the contract for the construction of the entire system awarded to the same person. The bids will probably be publised next week.

NEW COMPANIES.—Roberts Bros.' Drain & Seepage Ditch Co., Denver, Colo.; $10,000; T. G. Roberts, J. Roberts, G. D. Roberts.——Arkansas Valley Water Power & Irrigation Co., Kendall, Kan.; $20,000; Franklin Wright, C. M. Nation, John H. Bagnall, George Hall, E. E. Carter.——East Prineville Irrigation Co., Prineville, Ore.; $300.

SEWERS.

WESTBROOK, ME.—Plans are nearly completed for a system, according to reports.

LANCASTER, N. H.—The town has voted to put in a system this summer, the cost not to exceed $25,000.

PORTSMOUTH, N. H.—Plans for a system have been completed by L. E. Scruton.

RUTLAND, VT.—The city has voted to issue $25,000 of bonds for sewers.

EVERETT, MASS.—Bids are asked until March 31 for constructing 2,315 lin. ft. of 24-in. brick sewer, and about 20,000 lin. ft. of 12 to 6-in. pipe sewers, the work including 29,000 cu. yds. earth and 300 cu. yds. rock excavation.

FRANKLIN, MASS.—The board of health has recommended the construction of a system at once.

MALDEN, MASS.—Bids are asked until March 29 for constructing about 18 miles of pipe sewer. G. A. Wetherbee, Cy. Engr.

MEDFORD, MASS.—J. D. Street, Chm. Comm., informs us that the construction of proposed sewers will probably be commenced in three weeks.

MELROSE, MASS.—Authority will be asked to issue $100,000 in bonds for sewer purposes.

WEST NEWTON, MASS.—Bids are asked until April 5 for building about 1½ miles of brick and four miles

of pipe sewers, as stated in our advertising columns. H. D. Woods, Cy. Engr.

WINCHESTER, MASS.—The town treasurer has been instructed to issue $50,000 of 4% bonds to commence the proposed sewer work.

WOONSOCKET, R. I.—The council has voted to issue $50,000 of bonds for sewers.

DANBURY, CONN.—The aldermen have voted to contract with the Woolf Disinfecting Co., New York, for a license to use its process in disposing of the city's sewage. This plan is the outgrowth of the litigation over the outfall sewer.

NEW BRITAIN, CONN.—Sewers have been ordered constructed in two streets.——It is proposed to construct a main sewer in West Main St.; estimated cost, $18,000 to $37,000.

CORTLAND, N. Y.—Bids are asked until April 12 for constructing about 12 miles of sewers, as stated in our advertising columns. Fred. Hatch, Clk.

ITHACA, N. Y.—J. H. Fuertes is preparing plans for a system of sewerage and drainage for this place and Rudolph Hering has been retained as consulting engineer of the work.

YONKERS, N. Y.—Bids were received for building a sewer in North Broadway and Wells Ave., as follows: Brendlinger & Nearing, $26,495 (awarded contract); H. C. Brancey, $26,800; John Madigan, $27,999; John A. Murphy, $28,500; F. G. McElmeel, $28,800; J. & G. Stewart, $28,880; Carroll & Callahan, $28,912; Dougherty & Berrigan, $29,099.

BAYONNE, N. J.—The city surveyor has been directed to prepare plans for an extension of the 34th St. main sewer.

ELIZABETH, N. J.—The street commissioner has been directed to ask for bids for constructing a sewer in Livingston St.

WOODBRIDGE, N. J.—Bids are asked for constructing 3,000 ft. of 8-in. pipe sewer. F. F. Anness, Treas. Woodbridge Sewage Co.

WOODBURY, N. J.—D. T. Mathers, Cy. Clk., writes us that the city is discussing the question of sewerage, but that no plans have been prepared and a new council organizes March 20.

KITTANNING, PA.—Alexander Potter, New York, has been engaged to design and superintend the construction of a system of sewers for the borough. The advertisement for this work will appear in two weeks.

PHILADELPHIA, PA.—It is proposed to appropriate $939,000 for building main sewers.

WILLIAMSPORT, PA.—Bids are asked until March 26 for constructing about 1,000 ft. of 48-in. brick sewer and 1,350 ft. of 24 to 15-in. pipe sewer. W. J. Driesbach, Cy. Clk.

ALEXANDRIA, VA.—The Pennsylvania Sanitary Sewerage Co. is reported as negotiating to put in a system.

RICHMOND, VA.—The council has voted to issue $70,000 of 4% bonds for constructing sewers.

PARKERSBURG, W. VA.—The council has voted in favor of issuing $25,000 of bonds for sewers and paving.

MERIDIAN, MISS.—Bids are asked until May 1 for constructing the 17 miles of sewers noted last week. J. A. Mooser, Cy. Clk.

NEWPORT, KY.—Plans have been prepared for sewers in seven streets.

MANSFIELD, O.—The city engineer has been directed to prepare plans for sewers in two streets.

NILES, O.—The city clerk has been directed to ask for bids for constructing a sewer in Main St.

RAVENNA, O.—The council is reported as considering the construction of a system; estimated cost, about $25,000.

SANDUSKY, O.—Bids are asked until March 27 for constructing tile drains and catch basins in Oakland Cemetery. A. W. Judson, Cy. Engr.

MARLETTE, MICH.—The citizens are reported as about to vote on bonding the city for constructing a 24-in. sewer.

PORT HURON, MICH.—It is reported that the council is considering the building of a sewer to cost $57,000 for wards 9 and 10.

CHICAGO, ILL.—Bids are asked until March 24 for constructing drains and sewers in 30 streets. H. J. Jones, Comr. Pub. Wks.

PEORIA, ILL.—Bids are asked until April 6 for constructing 1,773 lin. ft. of 36 to 24-in. brick and 25,425 lin. ft. of 18 to 6-in. pipe sewer, as stated in our advertising columns. J. A. Harman, Cy. Engr.

PORTAGE, WIS.—The question of sewerage continues to be agitated.

BOONE, IA.—R. M. Mitchell, Cy. Engr., writes us that the contract for sewers in district No. 1 has been awarded to Geo. J. Baer, Kansas City, at $70,695. There were 21 bids received, the highest being $148,689. The itemized prices will be published next week.

DAVENPORT, IA.—Bids are asked until March 31 for constructing a 12-in. vitrified sewer. E. W. Boynton, Comr. Pub. Wks.

GAINESVILLE, TEX.—It is reported that a system will be put in.

LONDON, ONT.—Plans and estimates for a system are to be prepared, according to reports. The board of health has recommended the downward intermittent filtration method of sewage disposal. Alderman F. J. Fitzgerald, Chn. Bd.

STREETS.

MERIDEN, CONN.—Bids are asked until March 29 for a supply of brick, cement and castings. W. S. Clark, Cy. Engr.

BROOKLYN, N. Y.—The Brooklyn Bridge trustees have received the following bids for paving on Liberty St.: M. J. Dady, $23,047 (awarded contract); J. F. Gillen, $24,868; Luck & Fitzgerald, $29,097; Thomas McCann, $25,141; E. J. McKeever & Bro., $26,421; Thomas Monahan, $27,096.

JAMESTOWN, N. Y.—Bids are asked by the board of public works until March 28 for furnishing and laying 44,000 sq. yds. brick paving, 1,000 sq. yds. stone paving, and 16,000 lin. ft. curbing, as stated on advertising columns.

NEW YORK, N. Y.—Bids are asked by the department of parks until March 30 for constructing the proposed speedway between High Bridge and Dyckman St., the work including 210,500 cu. yds. excavation, 380,000 cu. yds. filling, 350,000 cu. yds. dredging, 2,000 cu. yds. rock excavation below low water, 3,775,000 cu. ft. crib bulkhead, 36,000 lin. ft. of piles, etc.; estimated cost, $1,175,000. Bids are asked by the department of parks until March 30 for furnishing 17,000 cu. yds. of gravel, 2,500 cu. yds. of trap rock stone, and one 15-ton Harrisburg double-engine steam road roller.

LANSDALE, PA.—Bonds for $8,000 have been issued for street improvements.

PHILADELPHIA, PA.—It is reported that the city will repave over a hundred streets, most of the work being done with asphalt, and the remainder with brick and Belgian blocks.

SHAMOKIN, PA.—An ordinance has been passed to pave part of Shamokin St. with asphalt.

SUNBURY, PA.—The burgess has been instructed to ask for bids for paving Market St.

CLEVELAND, O.—The Sterling Paving Co. has been incorporated with a capital stock of $50,000.

DAYTON, O.—Bids are asked until April 5 for grading and gravelling 12 streets. C. A. Herbig, Cy. Comp.

SPRINGFIELD, O.—Bids are asked until March 31 for grading and graveling seven streets. S. J. Wilkerson, Cy. Clk.

VAN WERT, O.—Bids will be received about April 25 for 30,000 sq. yds. of brick paving, 15,000 lin. ft. of curbing, and for macadamizing two streets. G. L. McKibben, Cy. Engr.

YOUNGSTOWN, O.—Bids are asked until April 13 for repairing and laying cement and stone sidewalks. H. W. Calvin, Clk.

ALTON, ILL.—The council is discussing the issuing of $30,000 of bonds for street improvements.

ST. LOUIS, MO.—It is reported that bids will soon be asked for by the board of public improvements for repaving several streets and alleys with brick. Ordinances have been adopted for paving two streets with asphalt and three with telford macadam.

ST. LOUIS, MO.—Bids are asked for paving 3,370 ft. be asked by the board of public improvements for and Carr St., this city, work to commence April 1. M. A. Hansen, Asst. Engr, St. Louis, Iron Mountain & Southern Ry.

DENVER, COLO.—H. F. Meryweather, Engr. Bd. Pub. Wks., is investigating the pavements of other cities with a view to improving the streets in this city.

ELECTRIC LIGHT AND POWER.

AMHERST, MASS.—The committee on agriculture has reported a bill recommending that an electric light plant be constructed at the agricultural college, to cost $7,000.

MARBLEHEAD, MASS.—The town has voted to put in an electric light plant at an estimated cost of $50,000.

BROOKLYN, N. Y.—Bids are asked until April 5 for plans and estimates for lighting the cars of the Brooklyn Bridge by electricity; also for heating them; also for propelling them. C. C. Martin, Supt.

IRVINGTON, N. J.—A committee of two has been appointed to confer with the Clinton township committee concerning the putting in of a plant for lighting the township streets. It is thought that a plant with six miles of wire and 500 36-c. p. incandescent lights, to cost $11,000, will serve the purpose.

LILLY, PA.—The Lilly Electric Light, Heat & Power Co. will petition for a charter, to light this place and Portage, and the townships of Cresson, Washington, Portage and Munster; incorporators, Edward O'Brien, George Brant, M. K. Piper, J. R. Kelly.

MORRISVILLE, PA.—It is reported that work will soon be commenced on the dam in the Delaware River at this place to furnish power for the New Jersey & Pennsylvania Electric Co.

ANNAPOLIS, MD.—A charter has been asked for by O. D. Barrett and J. B. Cotton to incorporate the Great Falls Power Co., which proposes to utilize the Great Falls of the Potomac River to furnish electric light and power to the District of Columbia. The legislature of Virginia has already granted the company a franchise.

BALTIMORE, MD.—Authority has been asked to issue bonds for $500,000 for a municipal electric light plant.

CHARLOTTESVILLE, VA.—The Charlottesville and University electric light plant was burned on March 12; loss, about $18,000.

COLUMBIANA, O.—The city will vote on issuing bonds for a plant, according to reports.

NEW ATHENS, ILL.—A committee has been appointed to investigate lighting plants of other towns with a view to putting in a plant at this place.

ROODHOUSE, ILL.—Bids are asked for lighting the city for 5 to 10 years. G. W. Armstrong, Mayor.

MINNEAPOLIS, MINN.—F. W. Cappelen, Cy. Engr., has prepared plans for a municipal electric light plant and a resolution has been introduced in the council to issue $160,000 of bonds for the construction of the plant.

HOOPER, NEB.—It is reported that this place is about to construct an electric light plant.

CORNING, ARK.—An electric light plant will probably be put in soon by J. E. Matthews, according to reports.

VAN ALSTYNE, TEX.—It is reported that an electric light plant will be put in.

SPOKANE, WASH.—The Lidgerwood Electric Ry. Co. has petitioned the council for a franchise for an electric light and power plant.

NEW COMPANIES.—The Chagrin Falls Electric Light Co., Chagrin Falls, O.; $10,000; W. E. Guyant, J. W. Hutchinson, E. J. Bailey, G. D. Gifford.——Brookville Electric Light Co., Eau Claire, Wis.; $15,000.——The Citizens' Electric Light Co., Leadville, Colo.; $25,000; D. Lasalle, G. P. Brown, R. J. Cary, H. H. Tomkins, and J. H. Maxwell.

CONTRACT PRICES.

DREDGING.—Philadelphia, Pa.—The port wardens have awarded the contract for dredging all docks on Delaware River front not belonging to the city to the American Dredging Co., at 13.4 cts. per cu. yd. Fred L. Somers bid 14 cts. for the work.

BRIDGE.—Boston, Mass.—C. G. Parsons, Ch. Clk. Eng. Dept., writes us that the following bids were received for furnishing all material and constructing the steel superstructure for Dover St. bridge, column 1 being for superstructure of fixed spans, including the cantilever portions, wooden flooring of said spans and of the draw span; 2, superstructure of draw-span above the turntable, 240,000 lbs. per lb.; 3, turntable and pier drum, 110,000 lbs., per lb.:

	1.	2.	3.
		cts.	cts.
D. H. Andrews, Boston	$28,320	2.34	3.54
Edge Moor Brdg. Wks., Wilton, Del.	28,435	2.4	3.77
Cofrode & Saylor, Philadelphia	33,970	2.74	4.45
Pennsylvania Steel Co., Steelton, Pa.	28,435	2.48	5.3
Berlin Iron Bridge Co., E. Berlin,	33,213	3.25	7.
Penn Bridge Co., Beaver Falls, Pa.	31,677	2.85	5.98
R. F. Hawkins, Springfield, Mass.	30,000	2.61	3.54

WATER-WORKS.—Saltsburg, Pa.—Robt. H. Wilson, Engr., has sent us a statement of the bids received March 10 for the proposed water-works. The lowest bid for 192 tons of cast iron pipe and 7,800 lbs. special castings was that of the Anniston Pipe & Foundry Co. (F. B. Hawkins & Co., Agts., New York), at $20.50 per ton of 2,240 lbs. and 2 cts. per lb. for specials. Bids for fourteen 4-in., five 6-in. and two 8-in. gates ranged from $6.60 to $8, $10.80 to $13.50 and $15.65 to $19 each, respectively; 8-in. check valve, $17.57 to $39.50; 19 hydrants, $18.70 to $23.86; 20 gate boxes, $2.65 to $3.50; laying 4-in., 6-in. and 8-in. pipe, 17 to 27½ cts., 18 to 29½ cts. and 19½ to 36½ cts., respectively. The bids for the works complete are given under Water-Works.

STOP COCKS.—Boston, Mass.—The water board has received the following bids for three 36-in., nine 30-in., two 24-in. and four 20-in. stop cocks: Josiah H. Long, Boston, 36-in., $353.83; 30-in., $267.31; 24-in., $151.26; 20-in., $132.23; total, $4,208.72 (awarded contract). Kennedy Valve Mfg. Co., $450; $275; $170; $120; total, $4,645; Coffin Valve Co., $900; $375; $240; $190; total, $6,415.

PIPE.—Newark, N. J.—The contract for 30,000 ft. of 6-in. cast iron pipe has been awarded to the Warren Foundry & Machine Co., at $20.05 per ton of 2,240 lbs., delivered in Newark. This is said to be $4 per ton less than ever before paid by the board.

Zanesville, O.—The contract for pipe for extensions of the water mains during 1894 has been awarded to the Ohio Pipe Co., at $17.85 per ton. This is claimed to be the lowest price ever paid for cast iron pipe in this city. The highest of five bids was $21.75 per ton.

ELECTRIC LIGHTING.—York, Pa.—F. B. Loucks, Secy. Com., writes us that the contract for lighting the city has been awarded to the Edison Electric Co., at 25 cts. per light per night for 2,000-c. p. lights, each light to burn all night and every night.

PIPELAYING.—Jersey City, N. J.—The total bids received for furnishing and laying 18,500 ft. of 12-in. cast iron pipe were published in our issue of March 8. The itemized prices were as follows:

Quantities.	Geo. Keiss.	J. J. Shea.	C. A. Judge.	Inman Bros.	Ed. O'Neil.	J. Hopkins.	Harrington.	Henry Byrne.	Geo. Clarke.	Condon.
12-in. pipe, laid, 18,500 ft..	$1.40	$1.30	$1.17	$1.25	$1.30	$1.24	$1.18	$1.15	$1.12	$1.05
12-in. water gates, set, each.	40.00	60.00	75.00	45.00	60.00	75.00	30.00	55.00	40.00	65.00
Rock excav., 750 cu. yds., at	2.00	5.00	4.00	3.50	1.50	1.40	2.00	2.00	3.00	1.00
Repaving, 540 sq. yds.	0.20	0.40	1.00	0.25	0.20	0.20	0.40	0.25	0.40	0.20
Relay'g b'ge stone, 50 sq. ft.	0.05	0.04	0.10	0.10	0.06	0.10	5.00	0.05	0.10	0.10
Bridging over ry. cut, ft.	500.00	10.00	10.00	6.00	12.00	12.00	0.05	10.00	7.00	9.00

BRICK PAVING.—Gas City, Ind.—The contract for paving Main St. with brick has been awarded to M. A. MacCarron & Son, Detroit, at $12.75 per lin. ft. for 4,265 lin. ft., 50 ft. wide between curbs, and $11.33 per lin. ft. for 727 ft., 40 ft. wide. It is stated that the Hallwood block will be used, with a foundation of sand and concrete, and 4-in. sandstone curbing.

Troy, N. Y.—The following bids were received for paving two streets with brick: Patrick McKenna, Troy, $2.65 per sq. yd. for pavement; 60 cts. per lin. ft. for new bridge stone; 10 cts. for old bridge stone; $1.05 for new curb; 10 cts. for old curb; D. G. Grannis, Syracuse, $2.45; 52 cts.; 10 cts.; 97 cts., and 20 cts., respectively.

Rock Island, Ill.—A. D. Huesing, Cy. Clk., informs us that the followin bids were received for paving 23d St. with a single course of brick upon a macadam and sand foundation: Rockford Construction Co., Rock Island brick, commercial size, $1.32 per sq. yd.; same, new city standard size, $1.37; Galesburg, commercial size, $1.52; Berea curbing, 58 cts. per lin. ft.; resetting, 10 cts. Atkinson & Oloff, Galesburg brick, commercial size, $1.36; Berea curbing, 56 cts.; resetting, 8 cts. Edwards & Walsh Constn. Co., Galesburg brick, $1.39; Rock Island, $1.25; same, new standard, $1.30; Cleveland curb, 56 cts.; resetting, 6 cts. R. J. McGee, Galesburg brick, $1.32½; Cleveland curb, 51 cts.; resetting 4 cts.

Kansas City, Mo.—H. P. Langworthy, Secy. Bd., writes us that contracts have been awarded to F. P. McCormick for paving five streets with brick, at $1.39½ to $1.58 per sq. yd., and that for paving one street to Kansas City Bldg. & Constn. Co., at $1.28; total of six contracts, $15,987. The bids were practically the same on all the streets, those for 15th St. being as follows: R. A. Taylor & Co., $1.64 and $1.63; T. Brosnahan, $1.65; M. Mense, $1.54½; Robt. J. Boyd, $1.57; Geo. J. Baer, $1.72; Jas. O'Donnell, $1.57; Kansas City Bldg. & Constn. Co., $1.72; St. Joseph Paving Brick Co., $1.55; H. S. Trestrail, $1.64½; F. P. McCormick, $1.45½.

SEWERS.—Troy, N. Y.—Contracts for constructing tile sewers have been awarded to Everline & Devine, at $1.27 to $1.70 per lin. ft. for 15-in., $1.61 to $1.70 for 12-in. and 40 to 45 cts. for laterals.